SOLVAY

Dean, Ouisha <ouisha.dean@solvay.com>

Fwd: FW:

1 message

Brown, Tim <tim.brown@solvay.com> Tue, Sep 3, 2013 at 10:13 AM
To: Jim Phillip <Jim.Phillip@solvay.com>, David Hansen <david.hansen@solvay.com>, Ryan Schmidt <ryan.schmidt@solvay.com>, Ouisha Toenyes <ouisha.toenyes@solvay.com>

fyi

---------- Forwarded message ----------
From: **Tim Martin** <tmartin@airsci.com>
Date: Tue, Sep 3, 2013 at 9:46 AM
Subject: FW:
To: tim.brown@solvay.com
Cc: Rodger Steen <rgsteen@airsci.com>

Tim,

I spoke with Sam at Sinclair and he was very helpful. See attached for the Sinclair permit application – of interest are the BACT cost calculations on page 111 of the PDF for the 233 MMBtu/hr gas-heater.

I'll call you shortly to discuss this in the context of our Solvay calculations.

-Tim

From: Sam Greene [mailto:sgreene@sinclairoil.com]
Sent: Tuesday, September 03, 2013 10:08 AM
To: tmartin@airsci.com
Subject:

SOLVAY2016_1.2_004539

Sam Greene P.E.

Corporate Environmental Engineer

Sinclair Oil Corporation

(801) 524-2729

sgreene@sinclairoil.com

--
Tim Brown
Environmental Services Supervisor
(307) 872-6570
tim.brown@solvay.com

Crude Oil Optimization Project.pdf
5955K

Certified Mail
Return Receipt Requested

 # 7008 0500 0001 0314 2856

October 10, 2011

Mr. Chad Schlichtemeier
NSR Program Manager
Air Quality Division
Wyoming Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, Wyoming 82002

Re: Sinclair Wyoming Refining Company (SWRC)
Crude Oil Optimization Project
Transmittal of Construction Permit Application

Dear Mr. Schlichtemeier:

Sinclair Wyoming Refining Company (SWRC) is planning to increase the crude oil refining capacity and implement other miscellaneous projects at its petroleum refinery located in Sinclair, Wyoming. Attached please find the construction permit application required by the Wyoming Air Quality Standards & Regulations (WAQS&R). The crude optimization project consists of:

- Removal of the 581 Crude Unit heater firing rate limit and replacement of the 581 Crude Unit atmospheric distillation tower;

- Modification of the 583 Vacuum tower to accommodate the resulting increase in reduced crude feedstock from the debottlenecked 581 Crude Unit; and

- Allowing the combustion of sweetened refinery fuel gas in the Coker Flare to accommodate potential periods when the refinery may have to operate in a fuel gas imbalance condition.

In addition, this application includes the following projects that are unrelated to the increase of crude oil refining capacity:

- Removal of the firing rate limits for the #1 HDS heater, Naphtha Splitter heater and Hydrocracker H5 heater so that these units will able to fire at their design maximum firing rates. This change will eliminate the requirement for fuel gas flow monitor testing to demonstrate that these heaters operate at the sub-design firing rates specified in the current permit. Note that this action is being requested solely to eliminate the need for annual fuel gas flow meter testing.

- Installation of a new Naphtha Splitter and Benzene Saturation/Isomerization (BSI) Unit to provide the capability to reduce the benzene content in the refinery's gasoline product to meet the specifications of the February 2007 Mobile Source Air Toxics II (MSAT II) rule. This potential project is totally unrelated to the Crude Oil Optimization Project. Depending on SWRC's success at meeting MSAT II requirements using the current refinery configuration, SWRC may elect to forego installing a new Naphtha Splitter and/or BSI unit.

- Upgrade of the refinery's sour water stripping system which will include increasing the capacity of the existing sour water stripping system and installation of an additional sour water stripper. Sour water is a byproduct of the refining process that refers to water containing hydrogen sulfide and ammonia. A sour water stripper removes the H_2S and Ammonia gases from sour water using steam heat. The gases then go to the refinery Sulfur Recovery Plants where 99+% of the sulfur is recovered as product sulfur. The stripped water is either used in other refining processes or goes to the refinery wastewater treatment plant for processing. The installation of the new sour water stripper will improve the refinery's ability for continuous sour water stripping and is included in the project description for completeness.

- Installation of a new emergency air compressor that will supply instrument air to the refinery in the event of a power failure.

SWRC has conservatively elected to treat all of the projects described above as a single project from a New Source Review (NSR) applicability perspective. Because SWRC is located in an area that is designated as attainment with all National Ambient Air Quality Standards (NAAQS), Non-attainment New Source Review (NNSR) is not required. As described in the application, this project will trigger Prevention of Significant Deterioration (PSD) permitting requirements for the pollutants oxides of nitrogen (NO_X), carbon monoxide (CO), Volatile Organic Compounds (VOC), sulfur dioxide (SO_2), and Greenhouse Gases (GHG). Because EPA Region 8 currently has primacy over the processing of GHG permit applications for PSD sources in Wyoming, the GHG portion of the permit application is being submitted to EPA Region 8 under separate cover. This project will not trigger PSD permitting requirements for particulate matter (PM), particulate matter smaller than 10 microns (PM_{10}), or particulate matter smaller than 2.5 microns ($PM_{2.5}$). SWRC has also been working closely with the Federal Land Manager (FLM) to develop an approved protocol for the PSD-required analysis of Federal Class I area impacts. A copy of this application is also being provided to the FLM. The application demonstrates compliance with all PSD and WAQS&R requirements.

Please note that on June 30, 2008 SWRC entered into a Consent Decree (CD) with Wyoming and EPA (Civil Action No. 08CV 020-D). This application demonstrates that the proposed projects do not conflict with any CD provisions.

SWRC is planning to perform the activities included in this construction permit application in the 2012 timeframe. Because permit issuance is required prior to commencing actual construction, SWRC is available at any time to discuss this project and permit application with the Division. Please contact Mr. John Pfeffer, Environmental Manager, at (307) 328-3548 with any questions or comments regarding this transmittal.

Sincerely,

Jim Maguire
Refinery Manager

JM/sbg

attachment

cc:
M. Serres

cc: Electronic
J. Pfeffer
S. Greene
J. Maffuccio

SINCLAIR WYOMING REFINING COMPANY

CONSTRUCTION PERMIT APPLICATION

CRUDE OIL OPTIMIZATION PROJECT

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SOLVAY2016_1.2_004545

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1.0 Introduction

Sinclair Wyoming Refining Company (SWRC) is proposing to increase the crude oil refining capacity at its petroleum refinery in Sinclair, Wyoming. In addition, this application includes miscellaneous projects that are unrelated to the increase of crude oil refining capacity. This construction permit application is intended to satisfy all construction permit requirements in the Wyoming Air Quality Standards and Regulations (WAQS&R).

The refinery has submitted a complete Title V operating permit renewal application and is currently operating under the operating permit shield provisions in the WAQS&R. This application addresses the appropriate portions of SWRC's Operating Permit # 30-145 which has expired but is administratively continued. The refinery is also operating under the provisions of other various construction permits/waivers issued after submittal of the operating permit renewal application.

1.1 Actions to Optimize Crude Oil Throughput

The Crude Oil Optimization Project consists of:

- Removal of the 581 Crude Unit heater firing rate limit and replacement of the 581 Crude Unit atmospheric distillation tower;
- Modification of the 583 Vacuum tower to accommodate the resulting increase in reduced crude feedstock from the debottlenecked 581 Crude Unit; and,
- Allowing the combustion of sweetened refinery fuel gas (i.e. meeting the NSPS Subpart Ja H2S standards) in the Coker Flare to accommodate potential periods when the refinery may have to operate in a fuel gas imbalance condition.

1.2 Elimination of Firing Rates on Selected Heaters

In a project that is unrelated to the actions to expand crude processing capacity, SWRC is proposing to remove the firing rate limits on the #1 HDS heater, Naphtha Splitter Heater and Hydrocracker H5 heater so that these units will able to fire at their design maximum firing rates. This change will eliminate the requirement for fuel gas flow monitor testing to demonstrate that these heaters operate at the sub-design firing rates specified in the current permit. Note that this action is being requested solely to eliminate the need for annual fuel gas flow meter testing.

1.3 New Naphtha Splitter and/or Benzene Saturation/Isomerization Unit

SWRC is proposing to install a new Naphtha Splitter and Benzene Saturation/Isomerization (BSI) Unit to provide the capability to reduce the benzene content in the refinery's gasoline product to meet the specifications of the February 2007

Mobile Source Air Toxics II (MSAT II) rule. This potential project is totally unrelated to the actions to expand crude oil refining capacity. Depending on SWRC's success at meeting MSAT II requirements using the current refinery configuration, SWRC may elect to forego installing a new Naphtha Splitter and/or BSI unit.

1.4 Sour Water Stripper System Upgrade

Sour water is a byproduct of the refining process that refers to water containing hydrogen sulfide and ammonia. A sour water stripper removes the H_2S and Ammonia gases from sour water using steam heat. The gases then go to the refinery Sulfur Recovery Plants where 99+% of the sulfur is recovered as product sulfur. The stripped water is either used in other refining processes or goes to the refinery wastewater treatment plant for processing.

In order to upgrade of the refinery's sour water stripping system, SWRC is proposing to increase the capacity of the existing sour water stripping system and install a new sour water stripper. The new sour water stripper will provide the capability to treat sour water during periods of downtime for the current sour water stripper system. The sour water stripper system upgrade will improve the refinery's ability for continuous sour water stripping and is included in the project description for completeness.

1.5 New Emergency Air Compressor

A new emergency air compressor will be installed to supplement the existing emergency air supply system. The emergency air compressor system supplies instrument air to the refinery in the event of a power failure.

1.6 New Source Review Considerations

SWRC has conservatively elected to treat all of the projects described above as a single project from a New Source Review (NSR) applicability perspective. Because SWRC is located in an area that is designated as attainment with all National Ambient Air Quality Standards (NAAQS), Non-attainment New Source Review (NNSR) is not required. As described in the application, this project will trigger Prevention of Significant Deterioration (PSD) permitting requirements for the pollutants oxides of nitrogen (NO_X), carbon monoxide (CO), Volatile Organic Compounds (VOC), sulfur dioxide (SO_2), and Greenhouse Gases (GHG). Because EPA Region 8 currently has primacy over the processing of GHG permit applications for PSD sources in Wyoming, the GHG portion of the permit application is being submitted to EPA Region 8 under separate cover. This project will not trigger PSD permitting requirements for particulate matter (PM), particulate matter smaller than 10 microns (PM_{10}), or particulate matter smaller than 2.5 microns ($PM_{2.5}$). SWRC has also been working closely with the Federal Land Manager (FLM) to develop an approved protocol for the PSD-required analysis of Federal Class I area impacts. A copy of this application is also being provided to the FLM. The application demonstrates compliance with all PSD and WAQS&R requirements.

1.7 Consent Decree Implications

Please note that on June 30, 2008 SWRC entered into a Consent Decree (CD) with Wyoming and EPA (Civil Action No. 08CV 020-D). The application demonstrates that the proposed projects do not conflict with any CD provisions.

2.0 Permit Application Forms

DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

PERMIT APPLICATION FORM

Date of Application: 10/10/11

1. **Name of Firm or Institution** Sinclair Wyoming Refining Company

2. **Mailing Address**

P. O. Box 277		Sinclair	Wyoming
Number	**Street**	**City**	**State**
Carbon		82334	(307) 324-3404
County		**Zip**	**Telephone**

3. **Plant Location**

100 East Lincoln Highway		Sinclair	Wyoming
Number	**Street**	**City**	**State**
Carbon		82334	(307) 324-3404
County		**Zip**	**Telephone**

4. **Name of owner or company official to contact regarding air pollution matters:**

Jim Maguire		Refinery Manager	(307) 324-3404	
Name		**Title**	**Telephone**	
P. O. Box 277		Sinclair	Wyoming	82334
Number	**Street**	**City**	**State**	**Zip**

5. **General nature of business** Refining crude oil, SIC # 2911, NAICS # 324110

6. **Permit application is made for: X New Construction X Modification**
__ Relocation __ Operation __ Temporary Operation
__ Non-Routine Maintenance, Repair and Replacement

7. **Type of equipment to be constructed, modified, or relocated. (List each major piece of equipment separately.)**

Modified Units

Operating Unit	Emission Source
581 Crude Unit	581 Crude Unit Heater
583 Vacuum Unit	583 Vacuum Unit Heater
Flare	Coker Unit Flare
#1 HDS	#1 HDS Heater
Naphtha Splitter	Naphtha Splitter Heater
Hydrocracker Unit	H5 Heater
#1 SWS	#1 TGTU
#2 SWS	#3 TGTU / #4 TGTU

New Units

Operating Unit	Emission Source
BSI	BSI Heater
Tank Farm	100 M bbl tank
New and Modified Units	New Fugitive Emission Sources
Boilerhouse	New Emergency Air Compressor
#3 SWS	#3 TGTU / #4 TGTU

8. **If application is being made for operation of an existing source in a new location, list previous location and new location:**

Previous Location: Not Applicable

New Location: Not Applicable

9. **If application is being made for a crushing unit, is there: (mark all appropriate boxes)**

Primary Crushing	Control Equipment:	Not Applicable
Secondary Crushing	Control Equipment:	Not Applicable
Tertiary Crushing	Control Equipment:	Not Applicable
Recrushing & Screening	Control Equipment:	Not Applicable
Conveying	Control Equipment:	Not Applicable
Drying	Control Equipment:	Not Applicable
Other	Control Equipment:	Not Applicable

Proposed dates of operation (month/year) **Not Applicable**

10. Materials used in unit or process (include solid fuels):

The following is a list of feedstocks and estimated charge rates to modified sources and new sources:

Modified Units

Operating Unit	Emission Source	Material Charged	Average Charge Rate (nominal)
581 Crude Unit	581 Crude Unit Heater	Crude Oils	Approx. 55,000 BPD
583 Vacuum Unit	583 Vacuum Unit Heater	Reduced Crude	Approx. 30,000 BPD
Flare	Coker Unit Flare	Refinery Fuel Gas / Purchased Natural Gas	Variable
#1 HDS	#1 HDS Heater	Naphthas	Approx. 20,000 BPD
Naphtha Splitter	Naphtha Splitter Heater	Hydrotreated Naphthas	Approx. 20,000 BPD
Hydrocracker Unit	H5 Heater	V-10 Fractionator Bottoms (Kerosene, Diesel and heavier range hydrocarbons)	Approx. 18,000 BPD
#1 SWS	#1 TGTU Process Vent	Sour Water	Approx. 200 gpm
#2 SWS	#3 TGTU / #4 TGTU Process Vents	Sour Water	Approx. 200 gpm

New Units

Operating Unit	Emission Source	Material Charged	Average Charge Rate (nominal)
BSI	BSI Heater	Light Straight Run	Approx. 20,000 BPD
Tank Farm	100 M bbl tank	Gasolines	Approx. 20,000 BPD
Boilerhouse	New Emergency Air Compressor	Air	Approximately 1000 cfm (discharge conditions)
#3 SWS	#3 / #4 TGTU Process Vents	Sour Water	Approx. 200 gpm

11. Air contaminants emitted:

SO2, NO_X, PM, CO, VOC, HAP (see Appendices)

12. **Air contaminant control equipment:**

Emission Point	Type	Pollutant Reduced	Efficiency
581 Crude Unit Heater	Ultra-Low NOx Burners	NO_X	≤ 0.030 lb NO_X / MM Btu (HHV)
583 Vacuum Unit Heater	Ultra-Low NOx Burners	NO_X	≤ 0.030 lb NO_X / MM Btu (HHV)
Coker Unit Flare	None	N/A	N/A
#1 HDS Heater	Ultra-Low NOx Burners	NO_X	≤ 0.035 lb NO_X / MM Btu (HHV)
Naphtha Splitter Heater	Ultra-Low NOx Burners	NO_X	≤ 0.035 lb NO_X / MM Btu (HHV)
H 5 Heater	Ultra-Low NOx Burners	NO_X	≤ 0.035 lb NO_X / MM Btu (HHV)
BSI Heater	Ultra-Low NOx Burners	NO_X	≤ 0.030 lb NO_X / MM Btu (HHV)
100 M bbl tank	External Floating Roof	VOC/HAP	N/A
New Emergency Air Compressor	N/A	NOx, PM, CO	Meets NSPS Tier III Performance Standards
#1 SWS	Claus SRU / TGTU	SO2	≤ 250 ppmvd SO2 (dry 0% O2)
#2 SWS	Claus SRU / TGTU	SO2	≤ 250 ppmvd SO2 (dry 0% O2)
#3 SWS	Claus SRU / TGTU	SO2	≤ 250 ppmvd SO2 (dry 0% O2)

13. **Type of combustion unit:** (check if applicable):

A. Coal Not Applicable

1. *Pulverized* __:

General __; Dry Bottom __; Wet Bottom __; With Flyash Reinjection __; Without Flyash Reinjection __; Other

2. *Spreader Stoker* __:

With Flyash Reinjection __; Without Flyash Reinjection __; Cyclone __; Hand-Fired __; Other

B. Fuel Oil Not Applicable

Horizontally Fired __ Tangentially Fired

C. Refinery Fuel Gas X Natural Gas X

D. If other, please specify Not Applicable

Hourly fuel consumption (estimate for new equipment) See Below .

Size of combustion unit BTU heat input/hour See below for new equipment.

Operating Unit	Emission Source	Estimated fuel consumption (Mscf/d @ 1160 Btu/SCF) (HHV)	Size of combustion unit (MM Btu/hr, HHV)
581 Crude Unit	581 Crude Unit Heater	4,820	233.0
583 Vacuum Unit	583 Vacuum Unit Heater	1,330	64.2
Flare	Coker Unit Flare	2,070	100.0
#1 HDS	#1 HDS Heater	690	33.4
Naphtha Splitter	Naphtha Splitter Heater	960	46.3
Hydrocracker Unit	H5 Heater	930	44.9
BSI	BSI Heater	1,030	50.0

14. Operating Schedule all but New Emergency Air Compressor:
__24__ hours/day; __7__ days/week; __52__ weeks/year.
Peak production season (if any): __Not Applicable

Operating Schedule New Emergency Air compressor: __500__ hours/year.
Peak production season (if any): __Not Applicable

15. Fuel analysis:

Operating Unit	Emission Source	Btu Value (HHV)	Sulfur Content (refinery fuel gas / purchased natural gas)
581 Crude Unit	581 Crude Unit Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
583 Vacuum Unit	583 Vacuum Unit Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
Flare	Coker Unit Flare	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
#1 HDS	#1 HDS Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
Naphtha Splitter	Naphtha Splitter Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
Hydrocracker Unit	H5 Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)
BSI	BSI Heater	1,160 Btu/scf (typical)	≤ 162 ppmv H2S (3 hour rolling average) and ≤ 60 ppmv H2S (365 day rolling average)

Operating Unit	Emission Source	Btu Value (HHV)	Sulfur Content (diesel fuel)
Boilerhouse	New Emergency Air Compressor	130,000 Btu/gal (typical of diesel fuel)	< 500 ppmw Sulfur

16. **Products of process or unit:**

The following is a list of products, intermediates and estimated process / production rates from modified sources and new sources:

Modified Units

Operating Unit	Emission Source	Material Processed / Produced	Estimated Average Process / Production Rate (nominal)
581 Crude Unit	581 Crude Unit Heater	Fractionated Crude Oils	Approx. 55,000 BPD
583 Vacuum Unit	583 Vacuum Unit Heater	Light Vacuum Gasoil, Heavy Vacuum Gasoil, Vacuum Bottoms	Approx. 20,000 BPD
Flare	Coker Unit Flare	N/A	N/A
#1 HDS	#1 HDS Heater	Hydrotreated Naphthas	Approx. 15,000 BPD
Naphtha Splitter	Naphtha Splitter Heater	Light Straight Run, Naphtha, C3/C4 overheads	Approx. 20,000 BPD
Hydrocracker Unit	H5 Heater	V-10 Fractionator Bottoms (Kerosene, Diesel and heavier range hydrocarbons)	Approx. 18,000 BPD
#1 SWS	#1 TGTU Process Vent	Stripped Sour Water	Approx. 200 gpm
#2 SWS	#3 TGTU / #4 TGTU Process Vents	Stripped Sour Water	Approx. 200 gpm

New Units

Operating Unit	Emission Source	Material Processed / Produced	Estimated Average Process / Production Rate (nominal)
BSI	BSI Heater	Light / Heavy Benfree Product	Approx. 20,000 BPD
Tank Farm	100 M bbl tank	Gasolines	Approx. 20,000 BPD
Boilerhouse	New Emergency Air Compressor	Air	Approximately 1000 cfm
#3 SWS	#3 / #4 TGTU Process Vents	Stripped Sour Water	Approx. 200 gpm

17. Emissions to the atmosphere (each point of emission should be listed separately and numbered so that it can be located on the flow sheet): <u>See Figure 2.2</u>

18. Does the input material or product from this process or unit contain finely divided materials which could become airborne?

___ Yes **_X_ No**

Is this material stored in piles or in some other way as to make possible the creation of dust problems?

___ Yes **_X_ No**

List storage pile (if any): Not Applicable

Type of Material	Particle Size (Diameter or Screen Size)	Pile Size (Average Tons on Pile)	Pile Wetted (Yes or No)	Pile Covered (Yes or No)
Not Applicable				

19. Using a flow diagram:
(1) Illustrate input of raw materials.
(2) Label production processes, process fuel combustion, process equipment, and air pollution control equipment.
(3) Illustrate locations of air contaminant release so that emission points under items 11, 12 and 17 can be identified. For refineries show normal pressure relief and venting systems. Attach extra pages as needed.

<u>See Figure 2.1 Refinery Process Flow Diagram</u>

20. A site map should be included indicating the layout of facility at the site. All buildings, pieces of equipment, roads, pits, rivers and other such items should be shown on the layout.

<u>See Figure 2.2 Refinery Plot Plan</u>

21. A location drawing should be included indicating location of the facility with respect to prominent highways, cities, towns, or other facilities (include UTM coordinates).

<u>See Figure 2.3 Refinery Location Drawing</u>

"I certify to the accuracy of the plans, specifications, and supplementary data submitted with this application. It is my Opinion that any new equipment installed in accordance with these submitted plans and operated in accordance with the manufacturer's recommendations will meet emission limitations specified in the Wyoming Air Quality Standards and Regulations."

Signature	JPMaguire	**Typed Name**	**Jim Maguire**		
Title	**Refinery Manager**	**Company**	**Sinclair Wyoming Refining Company**		
Mailing Address	**P. O. Box 277**	**Telephone No.**	**(307) 324-3404**		
City	**Sinclair**	**State**	**Wyoming**	**Zip**	**82334**
P.E. Registration (if applicable)	**N/A**				
State where registered	**N/A**				

STATE OF WYOMING
Department of Environmental Quality - Air Quality Division
Permit Application
Reciprocating Engine Form

GENERAL INFORMATION

Company Name: Sinclair Wyoming Refining Company

Facility Name: Sinclair Wyoming Refining Company, New Emergency Compressor

ENGINE DATA

Manufacturer: Cummins Engine Co. Inc
Model: TBD
No. of Cylinders: 6 (est.)
Compression Ratio: 14.5:1 (est.)
Serial Number: TBD
Date Ordered: 2011 (est.)
Date Manufactured: 2011 (est.)

Type of Engine:
4 Stroke Cycle: X   2 Stroke Cycle:

Fuel Data:
Coal Bed Methane: N/A   Other: X Diesel
Engine Fuel Consumption (BTU/bhp-hr): N/A   Fuel Gas Heating Value (BTU/scf): N/A
117 lb / hr (max,est.)

	Nameplate	Site Rating	Operating Range
Horsepower:	400(est.)	400 (est.)	320-400 (typ,est)
Speed (rpm):	2100(est.)	2100(est.)	1400-2100(typ,est)

Exhaust Stack Height (m): 2.1   Diameter (m): 0.13   Temp. (K): 690   Velocity(m/s): 100

Note: Stack parameters are estimated

EMISSIONS DATA

NO_x + NMHC (Note: 1)		CO (Note: 1)		VOC (Note: 2)		HCHO (Note: 3)	
g/hp-hr	lb/hr	g/hp-hr	lb/hr	g/hp-hr	lb/hr	g/hp-hr	lb/hr
3.0	2.65	2.6	2.29	1.0	0.88	0.00375	0.0033

Note 1 Emission factors 40 CFR Part 89.112 for Tier III engines.
Note 2: Assume HC emission factor from 40 CFR Part 89.112 for Tier I engines.
Note 3: Emission factor per memo from Alpha-Gamma Technologies, Inc. to Sims Roy, EPA OAQPS ESD Combustion Group. Subject: Emissions Data for Reciprocating Internal Combustion Engines, 2/4/02.

Annual Operating Hours: 500

EMISSION CONTROL EQUIPMENT

Lean Burn: X   **NSCR Catalyst:** N/A   **AFR controller:** X   **SCR Catalyst:** N/A
Oxidation Catalyst: N/A   **Other:** N/A   **Describe:** N/A

Best Available Control Technology control cost analysis attached: yes ____ no X

ADDITIONAL INFORMATION REQUIRED

On separate sheets of paper, attach a copy of engine manufacturer's site rating, site emission estimates, general rating specification for engine model, and documentation of date of order and date of manufacture for each engine.

Figure 2.1 Refinery Process Flow Diagram

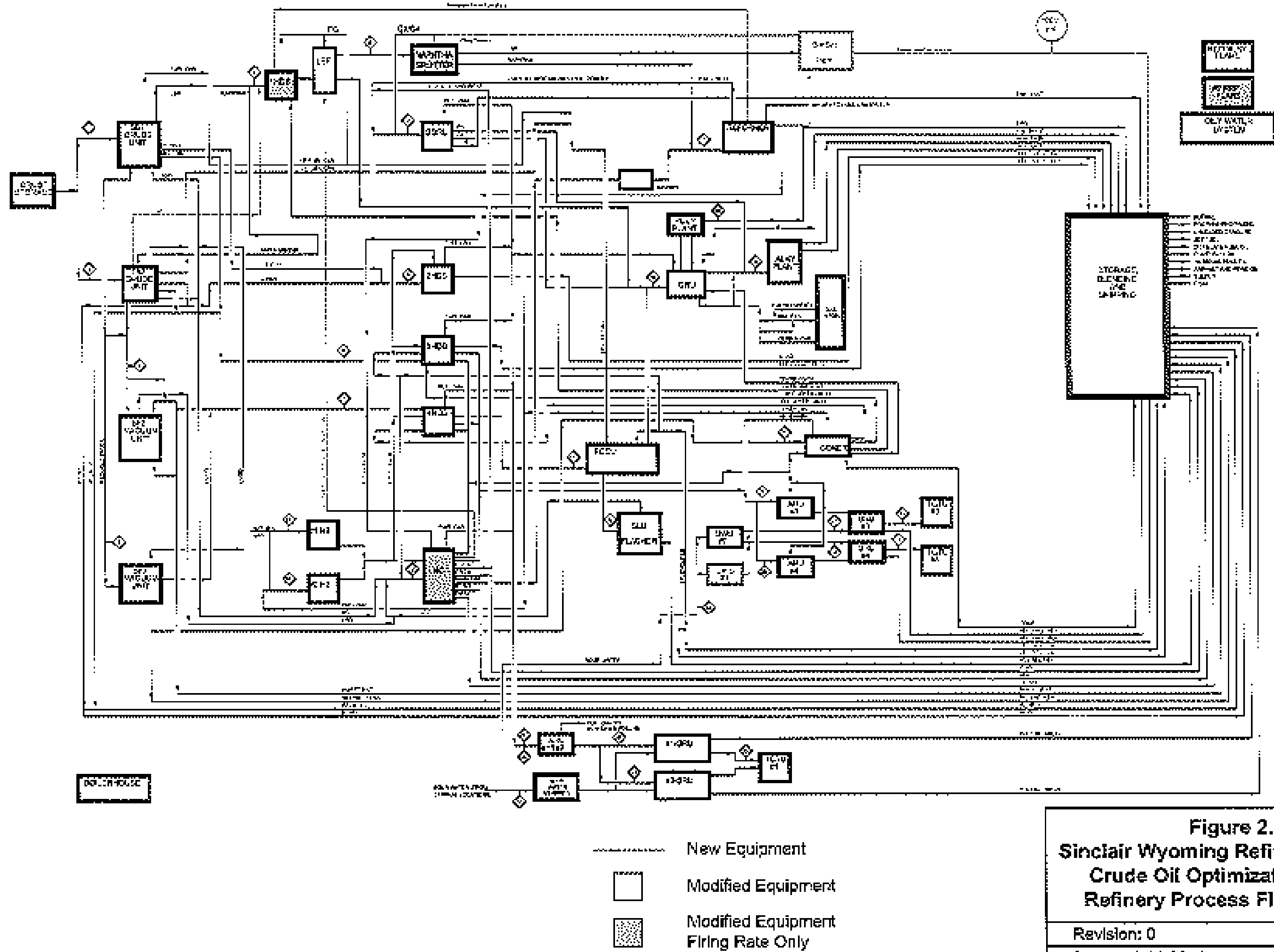

Figure 2.1
Sinclair Wyoming Refining Company
Crude Oil Optimization Project
Refinery Process Flow Diagram

Revision: 0
Date: 10/03/2011

Figure 2.2 Refinery Plot Plan

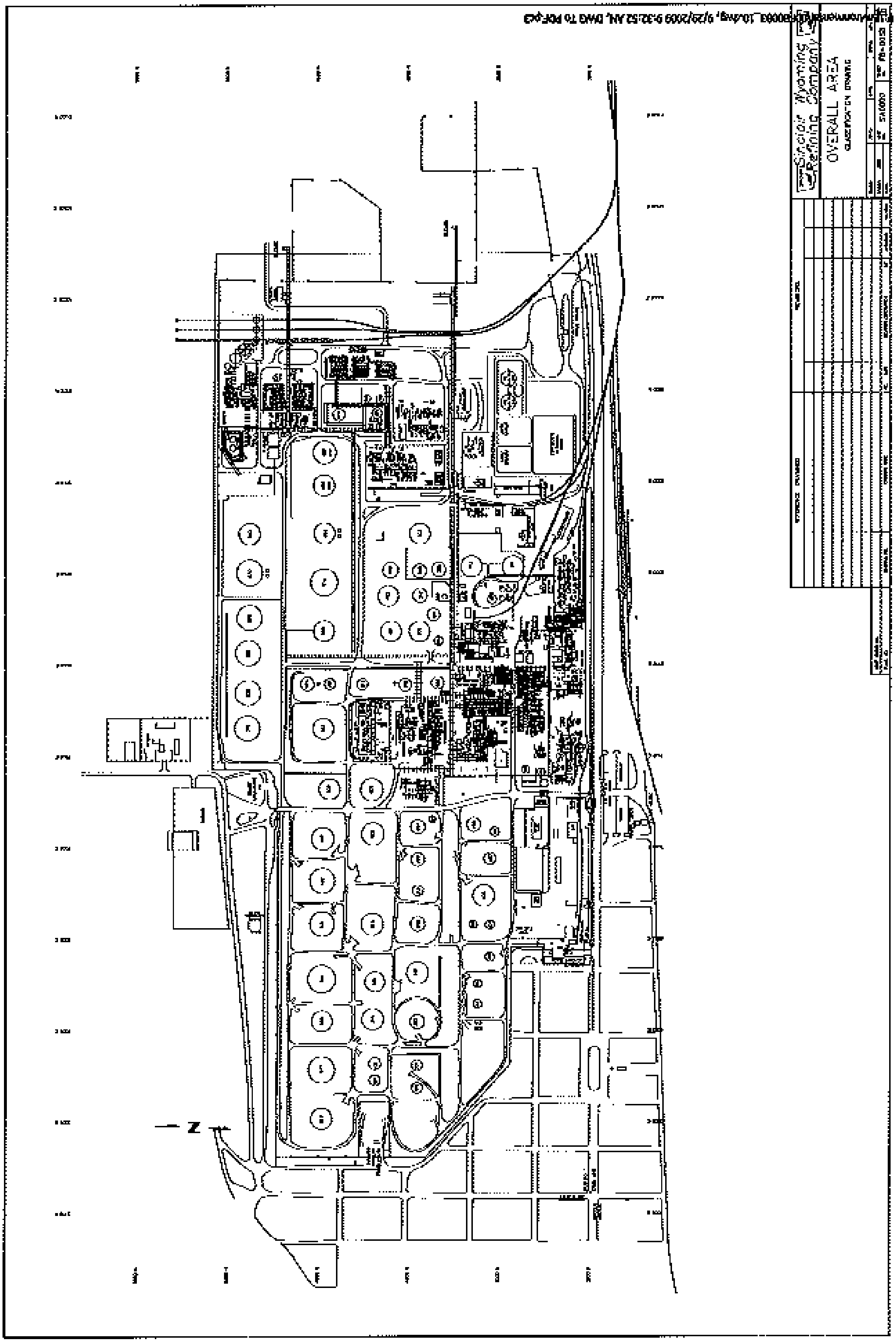

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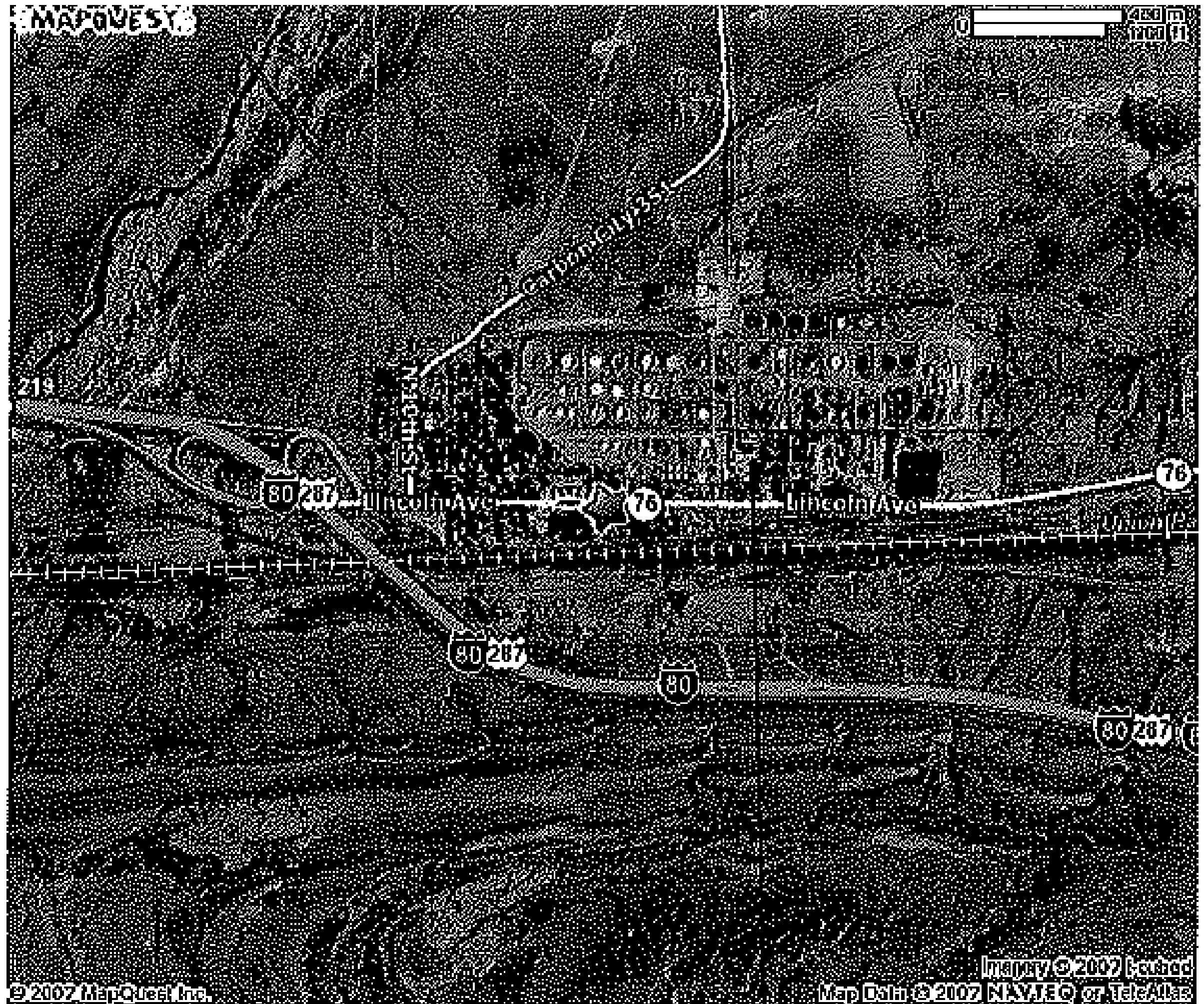
Figure 2.3 Refinery Location Drawing



Sinclair Wyoming Refining Company

3.0 Process Description

3.1 Project Overview

This permit application is comprised of the projects as described below. The overall refinery process flow and major equipment orientation is provided in the process flow diagram (Figure 2.1). In this figure, the new equipment is shown in red highlight and the modified equipment is shown in yellow and green highlight. The plot plan (Figure 2.2) indicates the proposed area of installation of equipment for the MSAT II Project.

A description of the new and modified units associated with this permit application is provided in the following sections. These process descriptions include general descriptions of process equipment with their upgrades (where applicable) and do not include all equipment that will be installed or modified. For example, there are heat exchangers, pumps, piping components, instruments, etc. that will be included in these projects but not explicitly listed in this permit application.

3.1.1 Increased Crude Oil Throughput

This project involves the following modifications:

- Removal of the firing rate limit at the 581 Crude Unit heater and replacement of the 581 Crude Unit atmospheric distillation tower. This heater was designed for a firing rate of 233 MM Btu/hr but limited by permit[1] to a firing rate of 133.2 MM Btu/hr. This project includes removal of the current firing rate limit to allow operation of this heater at its maximum capacity which will allow the 581 Crude Unit to operate at a higher crude oil throughput. To accommodate this increased throughput the 581 Crude Unit atmospheric distillation tower will also be replaced.

- Modification of the 583 Vacuum Unit. The vacuum tower system and vacuum heater will be modified to allow for an increase in charge rate.

- Allow the combustion of sweetened refinery fuel gas in the Coker Flare. SWRC has recently discussed with the Division its issues regarding fuel gas balance and routine flaring events. While SWRC is striving to operate in fuel gas balance, SWRC has identified operational scenarios where it may need the capability to combust sweetened refinery fuel gas in its flare system. Given this need, this construction permit application includes provisions for routing excess sweetened refinery fuel gas to the Coker Unit Flare during periods of fuel gas imbalance.

1 Permit MD-1351

3.1.2 Elimination of Firing Rate Limits on Select Heaters

This project is needed to eliminate the need for current heater refinery fuel gas flowmeter testing requirements and includes removal of the firing rate limits at the #1 HDS heater, Naphtha Splitter heater and Hydrocracker H5 heater.

3.1.3 New Naphtha Splitter and/or Benzene Saturation / Isomerization Unit (MSAT II Project)

SWRC is currently assessing the refinery's capability to meet the MSAT II provisions with the current refinery configuration. If it is determined the current refinery configuration cannot meet these standards, SWRC may elect to install a new Naphtha Splitter and/or Benzene Saturation/Isomerization (BSI) unit. This project will provide SWRC options for complying with current motor gasoline benzene content standards of the MSAT II rule.

The project includes the installation of new refinery process equipment with pumps, valves, and other fugitive emissions sources, an associated gas-fired heater and a new 100,000 barrel floating-roof storage tank.

3.1.4 Sour Water Stripper System Upgrade

SWRC is planning to install a new sour water stripper (#3 SWS) to provide additional capability to treat sour water and provide redundancy during periods of downtime for the current sour water stripper system. SWRC is planning to increase the capacity of the existing sour water stripping system that includes #1 SWS and #2 SWS.

3.1.5 New Emergency Air Compressor

A new diesel fuel driven emergency air compressor will be installed to supplement the existing emergency air supply system. The emergency air compressor system supplies instrument air to the refinery in the event of a power failure.

3.2 Modified Equipment

The following existing units will be modified (either physically modified or modified by removal of a current permit limitation) in conjunction with the Crude Oil Optimization Project. A description of the modified units is provided in the following sections. These process descriptions include general descriptions of process equipment with their upgrades (where applicable) and do not include all equipment that will be installed or modified. For example, there may be heat exchangers, pumps, piping components, instruments, etc. that will be included in this project but not explicitly listed in this permit application.

3.2.1 581 Crude Unit

SWRC is planning to eliminate the current firing rate limit at the 581 Crude Unit heater. Removal of this limit will allow the 581 Crude Unit to operate at enhanced throughputs up to its inherent hydraulic capacity. Additionally, this project will also replace the 581 Crude Unit atmospheric distillation tower.

A summary of the current firing rate limit, design firing rates and actual firing rates (average of 2009 and 2010) is provided below for the 581 Crude Unit heater.

Heater	Current Firing Rate Limit (MM Btu/hr)	Design Firing Rate Capacity (MM Btu/hr)	Actual Firing Rate -- Average 2009 and 2010 (MMBtu/hr)
581 Crude Unit Heater	133.2	233.0	102.5

3.2.2 583 Vacuum Unit

SWRC is planning to modify the 583 Vacuum Unit to allow the processing of additional reduced crude produced by the 581 Crude Unit modification. This unit will be physically modified as follows:

- Rework of the 583 heater heat exchange system. The existing heater has sufficient heat release capacity to process the additional reduced crude produced by the 581 Crude Unit.

- Installation of a larger vacuum producing system required to address higher cracked gas (non condensables) volumes associated with the 581 Crude Unit modification. The vacuum producing system uses eductors, with steam being the motive fluid, to produce vacuum. The increased steam needed for the eductors will be provided by waste heat recovery steam generation system on the 581 Crude Unit heater. In addition, the #1 H2 plant and #2 H2 plant both have waste heat recovery systems that will be used to meet steam requirements for this project. This project will result in a net steam increase from waste heat recovery systems and will not require any additional steam to be produced by refinery boilers. The following table provides the estimated steam demand for the refinery pre and post project.

Estimated* SWRC Steam Demand	Estimated Pre-Project Steam Demand from Boilers (total lbs/hr steam)	Estimated Post-Project Steam Demand from Boilers (total lbs/hr steam)
	262,704	254,078

* Note the estimated steam demand values are calculated assuming maximum production rates and do not necessarily reflect past actual refinery steam consumption.

3.2.3 Coker Unit Flare

SWRC is planning to modify the Coker Unit Flare to allow the routing of excess sweetened refinery fuel gas to the Coker Flare during periods of refinery fuel gas imbalance. This modification will include:

- Installation of piping and piping components from the refinery sweet fuel gas drum to the Coker Unit Flare.

The maximum capacity of the Coker unit Flare will remain unchanged. No upstream units will be affected by modification of the Coker Unit Flare (re: Section 3.4). In addition, a Continuous Emissions Monitoring System (CEMS) meeting the provisions of NSPS Subpart Ja will be installed to monitor the H_2S content of the flare gas.

3.2.4 #1 HDS Heater, Naphtha Splitter Heater and Hydrocracker H5 Heater

These heaters were recently retrofitted with Ultra Low NOx Burners (ULNB) and had firing rate limits imposed by permit[2]. The firing rate limits were needed because the ULNB used in the retrofits had higher design firing rates than the burners they replaced. Because of these firing rate limits, SWRC is required to confirm the accuracy of the fuel gas flow meters with annual testing[3]. This project includes removal of the current firing rate limits to allow operation of these heaters at their design firing rates without the need for annual fuel gas flow meter testing.

A summary of the current firing rate limits, design firing rates and actual firing rates (average of 2009 and 2010) is provided below.

2 Permit MD-1381A2, Condition 28 (1/29/08)
3 Permit MD-1381A2, Condition 29 (1/29/08)

Heater	Current Firing Rate Limit (MM Btu/hr)	Design Firing Rate Capacity (MM Btu/hr)	Actual Firing Rate - Average 2009 and 2010 (MMBtu/hr)
#1 HDS heater	24.0	33.4	13.0
Naphtha Splitter heater	34.5	46.3	10.6
Hydrocracker H5 heater	35.7	44.9	21.9

It is important to note these heaters have historically operated well below their currently permitted firing rates and SWRC anticipates operating below these maximum firing rates with the increased crude throughput. SWRC's desire to remove the current firing rate limits is due solely to the elimination of the fuel gas flow meter annual testing requirements.

3.2.5 Naphtha Splitter (MSAT II)

As part of the MSAT II project, SWRC will require improved fractionation in the Naphtha Splitter Unit to obtain a more precise distillation cut of the intermediate stream sent to the BSI Unit. Please note that beyond the potential fugitive emission component increases previously identified, these updates to the Naphtha Splitter Unit will not impact the existing Naphtha Splitter emission source (i.e., fired heater) potential to emit. Although this heater is not being physically modified, it has been included in the emissions analysis as part of a modified unit. These updates to the #1 HDS will include:

- Replace the existing Naphtha Splitter tower with a larger tower with 60 trays;
- Modify the Reactor Section by improving the hydraulics (piping and pumps)

3.2.6 #1 Sour Water Stripper (#1SWS) and #2 Sour Water Stripper (#2SWS)

SWRC is planning to increase sour water charge rate capacity of the #1 SWS and #2 SWS with the installation of new sour water charge pumps.

3.3 New Equipment

3.3.1 Fugitive Emission Components (Increased Crude Oil Throughput)

There may be minor additions of new fugitive emission components associated with the modified equipment (re: Section 3.2) and a conservative estimates of these new components is included in this application.

3.3.2 MSAT II Project

The MSAT II Project includes the following construction plans for new sources:

- Construct a new process unit, the BSI Unit, to reduce the benzene content of gasoline while maintaining its octane rating. This process unit will include a new gas fired heater with a heat input capacity of 50 MM Btu/hr.
- Construct a new 100,000 barrel (bbl) floating roof tank for storage of gasoline and intermediate products.
- Construct the interconnecting process and utility piping to tie the BSI Unit into the existing refinery process and utility systems. Pumps, flanges, valves, drains, and other piping components will be installed which may emit fugitive VOCs.

The MSAT II project also results in modification of the existing Naphtha Splitter tower by replacing it with a larger tower (see section 3.2.5). A new closed-loop glycol system will also be installed for the project, although this system will not emit any air pollutants.

3.3.2.1 BSI Unit (MSAT II)

The purpose of this process unit is to reduce the benzene concentration in gasoline while preserving the octane rating of the product.

Benfree™ is a process which reduces benzene in the feedstock through integrated reactive distillation. The process uses high-pressure pumps to withdraw benzene rich light fraction from the splitter where the benzene is converted to cyclohexane. Consequently, this conversion process affects the octane rating of the product. Note that the octane rating is distinct from the actual concentration of isomers of octane present in the product; octane rating is a measure of gasoline's tendency to pre-combust in an internal combustion engine.

In order to preserve the octane rating of the gasoline, SWRC will also utilize the Par-Isom™ process in conjunction with the Benfree™ process. The Par-Isom™

process uses a catalytic reaction to isomerize the hydrocarbon molecules, creating a blend with the appropriate octane rating.

The combination of the Benfree™ Par-Isom™ process trains are designated as the BSI Unit by the SWRC refinery. A new 50 MM Btu/hr rated gas-fired heater will be installed as part of the BSI Unit.

3.3.2.2 BSI Product Tank (MSAT II)

SWRC will construct a new, external floating roof storage tank to support the new BSI Unit operation. This tank will have a nominal storage capacity of 100,000 bbl, and will primarily be used to store gasoline intermediate with a Reid Vapor Pressure (RVP) of approximately 4. However, under certain circumstances this tank may hold other materials, so emission calculations for the tank were developed assuming the contents is gasoline with a RVP of 6.

The tank will have the following design characteristics:

Type of Tank: External Floating Roof
Diameter: 120 feet
Throughput: 10,327 Barrels per day (Bpd) (typical value - for emissions estimation only)
Paint color: White
Roof Type: Pontoon Deck
Tank Construction: Welded
Primary Seal: Mechanical Shoe
Secondary Seal: Rim-Mounted
Fittings: Access Hatches, Roof Legs, Non-Slotted Guidepoles

3.3.2.3 Fugitive Emission Components (MSAT II)

The new BSI Unit, the updates to the #1 HDS unit and the new storage tank will require the installation of piping components such as valves, pumps, flanges, and drains. The BSI Unit will also require the construction of interconnecting process and utility piping to tie the new unit into the refinery process and utility systems, which will require the installation of additional piping components. The new equipment in VOC service will result in potential fugitive emissions and are incorporated into the project emission calculations.

3.3.3 #3 Sour Water Stripper (3#SWS)

SWRC is planning to install a new sour water stripper (#3SWS) to provide additional capability and to treat sour water during periods of downtime for the current sour water stripper system.

3.3.4 New Emergency Air Compressor

SWRC operates an emergency air compressor system to provide instrument air to critical instruments in the event of a power failure. A new emergency air compressor will be installed to supplement the existing emergency air supply system. The new air compressor will be driven by a diesel engine meeting the provisions of 40 CFR Part 89.112 for Tier III engines. This engine will be limited to 500 hours of non emergency operation.

3.4 Non-Modified Equipment

The following units will not be physically modified or undergo a change in method of operation but may see an incremental increase in actual emissions from associated process unit emission sources as a result of the increase in crude oil throughput (section 3.1.1), elimination of the selected heater firing rates (section 3.1.2), operation of the MSAT II project (section 3.1.3) or operation of the upgraded sour water stripper system (section 3.1.4). The process units associated with the non-modified equipment have sufficient capacity to process the incremental increases in intermediate streams associated with the increased crude oil throughput. Emission sources associated with the non-modified equipment will have no increases in allowable emission rates with respect to previous permitting actions. Heater firing rates associated with the non-modified equipment will have no increases above the values used to calculate the allowable emission rates in previous permitting actions.

3.4.1 #1 and #2 Hydrogen Plants

Increased crude throughput will result in increased Hydrogen (H2) generation (needed for hydrotreating) at the refinery which will result in incremental increases in the firing rates of the heaters associated with these units. In addition, the new BSI Unit is expected to require a supply of up to 4 million standard cubic feet per day (MMscfd) of hydrogen beyond the amount of hydrogen needed for current refinery operations. This increased hydrogen may be produced by either the existing #1 or #2 Hydrogen plants and will require an incremental increase in the firing rate of the #1 and/or #2 Hydrogen plant Heaters.

During BSI Unit startup, a small incremental increase in steam production will be required. Startup will only occur for a two-day period approximately twice per year. This steam will be provided from the increased firing of the 581 Crude Unit heater, #1 H2 plant and #2 H2 plants which all have waste heat recovery systems used to produce steam.

3.4.2 #1 HDS

As identified previously, increased crude throughput will result in increased hydrotreating at the #1 HDS which will result in an incremental increase in the firing rate of the #1 HDS heater associated with this unit.

As part of the MSAT II project, SWRC will require #1 HDS to process the BSI Unit feedstock but will not result in any incremental increase in the firing rate of associated heaters. As a result of this project, light naphtha from the Hydrocracker and the 582 Crude Unit will now be fed to the #1 HDS. However, heavy naphtha from the Hydrocracker Unit, which is currently fed to the #1 HDS, will now be fed directly to the LEF Tower and Naphtha Splitter instead (see section 3.4.3). The flow of heavy Hydrocracker naphtha exceeds the combined flow of the two light naphtha streams, therefore the #1 HDS will not receive an overall increase in feed rate as a result of the MSAT II project. Note that beyond the potential fugitive emission component increases previously identified as part of the MSAT II Project, these updates to the #1 HDS will not impact any existing #1 HDS emission source (i.e., fired heater).

3.4.3 Light Ends Fractionator (LEF)

Increased crude throughput will result in increased throughput at the LEF which will result in an incremental increase in the firing rates of the heater associated with this unit.

As part of the MSAT II project, SWRC will require LEF Unit to process the BSI Unit feedstock. Please note that beyond the potential fugitive emission component increases previously identified, these updates to the LEF Unit will not impact any existing LEF emission sources (i.e., fired heater) at the SWRC refinery nor increase the processing capacity of the unit. As a result of this project, heavy naphtha from the Hydrocracker Unit, which is currently fed to the #1 HDS Unit, will now be fed directly to the LEF Tower.

There will be incremental increases in throughputs to the Light Ends Fractionator Unit and Naphtha Splitter Unit as a result of the increased firing rate at the 581 Crude Unit which will result in small incremental increases in the firing rates of the two heaters associated with these units.

3.4.4 781 Reformer

Increased crude throughput will result in increased throughput at the 781 Reformer which will result in an incremental increase in the firing rates of the heaters associated with this unit (reformer heaters 1 through 3 and the stabilizer heater). Currently, heavy naphtha from the Hydrocracker Unit is fed to the #1 HDS Unit. After implementation of the MSAT II Project, this heavy naphtha will instead be fed to the LEF Tower and processed through the Naphtha Splitter that will also result in an incremental increase in reformer heater firing.

3.4.5 #2 HDS

Increased crude throughput will result in increased hydrotreating at the #2 HDS which will result in an incremental increase in the firing rates of the heater associated with this unit. Light cycle oil (a kerosene/diesel range intermediate) from the FCCU may be routed to the #2 HDS Unit for further processing. Its capacity is limited by the hydraulic capacity of its charge pumps.

3.4.6 #3 HDS

Increased crude throughput will result in increased hydrotreating at the #3 HDS which will result in an incremental increase in the firing rates of the heater associated with this unit. Light cycle oil (a kerosene/diesel range intermediate) from the FCCU may be routed to the #3 HDS Unit for further processing. Its capacity is limited by the hydraulic capacity of its charge pumps.

3.4.7 #4 HDS

Increased crude throughput will result in increased hydrotreating at the #4 HDS which will result in an incremental increase in the firing rates of the heaters associated with this unit. The #4 HDS Unit supplies hydrotreated gasoil feed to the FCCU. Its capacity is limited by the hydraulic capacity of its charge pumps.

3.4.8 Fluid Catalytic Cracking Unit (FCCU)

Increased crude throughput will result in increased throughput at the FCCU which will result in an incremental increase in emissions from this source. The FCCU receives hydrotreated gasoils from the #4 HDS. Its capacity is limited by the hydraulic capacity of its charge pumps and it air blowers.

3.4.9 Hydrocracker Unit (HCU)

Increased crude throughput will result in increased hydrotreating at the HCU which will result in an incremental increase in the firing rates of the heaters associated with this unit. Light cycle oil from the FCCU may be routed to the HCU for further processing. Coker gasoil from the Coker Unit may also be sent to the HCU for further processing. Its capacity is limited by the hydraulic capacity of its charge pumps.

3.4.10 Gas Recovery Unit (GRU)

Increased crude throughput will result in increased throughput at the GRU. Overhead gases generated by the FCCU are sent to the GRU for processing/separation prior to sending them to the Alky Unit, Poly Plant or to storage. Its capacity is limited by the hydraulic capacity of its charge pumps. There are no point sources of emissions associated with the GRU.

3.4.11 Saturate Gas Recovery Unit (SGRU)

Increased crude throughput will result in increased throughput at the SGRU. Overhead gases generated by the HCU, Naphtha Splitter and Reformer are sent to the SGRU for processing/separation prior to sending them to the Alky Unit, Poly Plant or to storage. Its capacity is limited by the hydraulic capacity of its charge pumps. There are no point sources of emissions associated with the SGRU.

3.4.12 Poly Plant

Increased crude throughput will result in increased throughput at the Poly Plant. The Poly Plant processes gases from the GRU and produces a gasoline blendstock that is sent to storage. Its capacity is limited by the hydraulic capacity of its charge pumps. There are no point sources of emissions associated with the Poly Plant.

3.4.13 Alky Unit

Increased crude throughput will result in increased throughput at the Alky Unit. The Alky Unit processes olefins generated by the FCCU and butane/butylenes from storage to produce alkylate, a gasoline blendstock. Its capacity is limited by the hydraulic capacity of its charge pumps. There are no point sources of emissions associated with the Alky Unit.

3.4.14 Coker Unit

Vacuum Tower bottoms and Slurry from the FCCU (both heavy hydrocarbon intermediates) may be routed to the Coker Unit for further processing. Increased crude throughput will result in increased throughput at the Coker Unit which will result in an incremental increase in the firing rates of the heater associated with this unit. Its capacity is limited by the hydraulic capacity of its charge pumps.

3.4.15 Sulfur Recovery Plants (SRPs)

Intermediate streams throughout the refinery are routed to the various hydrotreater units for sulfur removal. The resulting acid gas generated by the hydrotreating units is processed through the following SRP systems:

- #1 and #2 Sulfur Recovery Units (#1SRU, #2 SRU) and their associated Tail Gas Treatment Unit (#1TGTU)
- The SRP #3 Sulfur Recovery Unit (#3SRU) and its associated Tail Gas Treatment Unit (#3TGTU)
- #4 Sulfur Recovery Unit (#4SRU) and its associated Tail Gas Treatment Unit (#4TGTU)

In addition, sour water stripper overhead gases from #1SWS, #2SWS and #3SWS are routed to #2SRU, #3SRU and/or #4SRU for processing. Increased crude throughput will result in an incremental increase in throughput at all SRPs.

3.4.16 Light Oil Loading Rack (LOLR)

Increased crude throughput will result in increased throughput at the LOLR. The increase in finished products may be distributed to commerce via the LOLR System. Its capacity is limited by the hydraulic capacity of its loading pumps and market demand.

3.4.17 Storage Tanks

Increased crude throughput will result in increased working loss emissions from the majority of the crude, intermediate and product storage tanks at the refinery.

3.4.18 Pressure Vessels

Increased crude throughput will result in increased pressure vessel throughput. There are no routine emissions associated with the pressure vessels.

3.4.19 Asphalt Plant

The increase in the production of vacuum tower bottoms or FCCU slurry associated with this project may be directed to the Asphalt Plant for processing. Please note the #2 Asphalt heater has been idled and is in the process of being permanently removed from service.

3.5 Unaffected Units

This section describes process units at the refinery that will not be debottlenecked, physically modified or experience a change in the method of operation as a result of the Crude Oil Optimization Project. The capacities of these process units are limited by the equipment as is but are identified in the following for application completeness.

3.5.1 582 Crude Unit / 582 Vacuum Unit

Throughput to these units will be unaffected by the increase in crude rate to the 581 Crude Unit. The 582 Crude Unit and 582 Vacuum Unit capacity is limited by the hydraulic capacity of their charge pumps.

3.5.2 Boilerhouse

The Crude Oil Optimization project will require additional steam generation for use as stripping steam at the 581 Crude Unit and 583 Vacuum Unit eductor system. Additionally, during normal operations, the new BSI Unit will not require any additional steam compared to current conditions, as the project involves gasoline-range intermediates, which do not require steam tracing. However, a small amount of steam will be required during startup of the BSI Unit. Startup of this unit is conservatively estimated to occur twice per year, and will take place over two days. During these startup periods, the refinery will be required to provide an incremental increase in steam that may be supplied by any of the steam generators at the refinery.

However, as identified previously in Section 3.2.2, this project will result in a net steam increase from waste heat recovery systems and will not require any additional steam to be produced by refinery boilers.

3.5.3 Flare Gas Recovery (FGR) System

SWRC is currently upgrading the FGR system to comply with the provisions of the Consent Decree[4]. These upgrades include several provisions to reduce the generation of refinery gas vented to the flare. After completion of these upgrades, SWRC believes the FGR system will be adequate to capture the routinely generated refinery fuel gases for treatment in the refinery's amine system for ultimate use as NSPS J and Ja compliance refinery fuel gas.

3.5.4 Oily Water Treatment System

The 581 crude unit and downstream units associated with the Crude Optimization Project will not see an increase in water throughput or wastewater generation associated with the Crude Optimization Project. The 581 desalter is designed to operate over a range of water/oil ratios, and running at the increased crude rate will result in operation at a lower water/oil ratio with the overall oily water generation remaining constant.

SWRC is currently in the process of upgrading its Oily Water treatment system in accordance with its settlement agreement with WDEQ/SHWD[5]. The operation of the upgraded Oily Water treatment system and enhanced controls will result in no additional emissions from waste water treatment.

3.5.5 Cooling Towers

Increased crude throughput may result in increased duty at the refineries cooling tower systems that include the following:

- 583 Cooling Tower
- Fluor Cooling Tower
- Marley Cooling Tower

4 Civil Action No. 08CV 020-D
5 Settlement Agreement for Notice of Violation Docket # 4713-10

- Coker Cooling Tower

These cooling towers operate at a constant water circulation rate that is independent of duty. Total dissolved solids (TDS) and Total suspended solids (TSS) content of the circulating water are controlled to prescribed levels currently in place at the refinery. Because there will be no change to the water circulation rate or TSS/TDS levels in the water, there will be no emission changes to these cooling towers associated with this project.

Additionally, there will be no change to the operation of the 582 Cooling Tower as a result of the project.

4.0 Permit Limitations

4.1 Estimated Emissions

4.1.1 New Sources

The proposed PTE (or proposed allowable emissions) for the new sources associated with the Crude Oil Optimization Project are presented in Table 4.1. This table includes proposed potential emissions for particulate matter (PM)/particulate matter smaller than 10 microns (PM_{10})/ particulate matter smaller than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), carbon monoxide (CO), and volatile organic compounds (VOC).

Table 4.1 Potential to Emit – New Sources

Operating Unit	Emission Source	Firing Rate for Allowable Emissions (MMBtu/hr)	$PM/PM_{10}/PM_{2.5}$ Emissions TPY	SO_2 Emissions TPY	NO_X Emissions TPY	CO Emissions TPY	VOC Emissions TPY
New Sources - Potential to Emit:							
BSI	BSI Heater	50.0	0.4	1.9	6.6	8.8	1.2
Tank Farm	New Tank (100M BBL)	N/A	N/A	N/A	N/A	N/A	7.8
Boilerhouse	New Emergency Air Compressor	N/A	<0.1	<0.1	0.7	0.6	0.2
Equipment Leaks	Fugitive Emissions/Drains	N/A	N/A	N/A	N/A	N/A	7.8
Total New Sources			0.4	1.9	7.3	9.4	17.0

Notes:

1. PM, PM_{10}, and $PM_{2.5}$ emissions are assumed equal for gas combustion sources.

4.1.2 Modified Sources

Table 4.2 presents the PTE from the modified sources associated with the project.

Table 4.2 Potential to Emit -- Modified Sources

Operating Unit	Emission Source	Firing Rate for Allowable Emissions (MMBtu/hr)	$PM/PM_{10}/PM_{2.5}$ Emissions TPY	SO_2 Emissions TPY	NO_X Emissions TPY	CO Emissions TPY	VOC Emissions TPY
Modified Sources - Potential to Emit:							
581 Crude Unit	581 Crude Heater	233.0	1.9	8.9	30.6	40.8	5.5
583 Vacuum Unit	583 Vacuum Heater	64.2	0.5	2.5	8.4	11.2	1.5
Coker	Coker Unit flare	100.0	0.8	3.8	29.8	162.1	27.6
781 Reformer	Naphtha Splitter Heater	46.3	0.4	1.8	7.1	8.1	1.1
Hydrocracker	Heater H5	44.9	0.4	1.7	6.9	7.9	1.1
#1 HDS	#1HDS Heater	33.4	0.3	1.3	5.1	5.9	0.8
Total Modified Sources			4.3	20.0	87.9	236.0	37.6

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4.1.3 Non-Modified Sources

The estimated incremental emissions from non-modified/ancillary sources are presented in Table 4.3. The emission rates shown are the emissions that will result from the incremental increases involving these sources.

Table 4.3 Potential to Emit – Non-Modified Sources

Operating Unit	Emission Source	Firing Rate for Allowable Emissions (MMBtu/hr)	$PM/PM_{10}/PM_{2.5}$ Emissions TPY	SO_2 Emissions TPY	NO_X Emissions TPY	CO Emissions TPY	VOC Emissions TPY
Non-Modified Sources							
781 Reformer	LEF Heater	24.0	0.2	0.9	3.7	4.2	0.6
	#1 Reformer Heater	44.6	0.4	1.7	6.8	7.8	1.1
	#2 Reformer Heater	74.8	0.6	2.9	11.5	13.1	1.8
	#3 Reformer Heater	22.4	0.2	0.9	3.4	3.9	0.5
	Stabilizer Heater	11.1	<0.1	0.4	1.7	1.9	0.3
Hydrocracker	Heater H1/H2	38.0	0.3	1.5	5.8	6.7	0.9
	Heater H3	56.0	0.5	2.1	8.6	9.8	1.3
	Heater H4	57.0	0.5	2.2	8.7	10.0	1.3
Coker	Coker Heater	145.0	1.2	5.5	21.0	25.4	3.4
	Coker (Material Handling)	N/A	Insignificant	N/A	N/A	N/A	N/A
780 FCCU	780 FCC Heater B3	10.0	<0.1	0.4	10.1	3.6	0.2
	780 FCC Heater H2	19.4	0.2	0.7	19.5	7.0	0.5
	780 FCCU Regenerator	N/A	70.5 / 70.5 / 48.7	57.8	66.6	504.0	23.3
#2 HDS	Charge Heater	28.0	0.2	1.1	4.3	4.9	0.7
#3 HDS	Charge Heater	18.0	0.1	0.7	2.8	3.2	0.4
#4 HDS	H2 Heater (25-HT-101)	22.0	0.2	0.8	3.4	3.9	0.5
	H2 Heater (25-HT-102)	24.0	0.2	0.9	3.7	4.2	0.6
#1 H2 Plant	#1 H2 Plant Heater	288.0	2.3	0.5	82.0	103.9	6.8
#2 H2 Plant	#2 H2 Plant Heater	288.0	2.3	5.6	12.6	25.2	6.8
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	N/A	0.2	84.6	9.2	39.4	0.7
Asphalt Loading	Asphalt Heater #1	8.0	<0.1	0.3	8.1	2.9	0.2
Tank Farm	Working Losses	N/A	N/A	N/A	N/A	N/A	0.7
Light Oil Loading	Loading Rack Flare	N/A	N/A	N/A	0.8	2.1	2.1
Total Modified Sources			80.3 / 80.3 / 58.6	171.4	294.3	787.1	54.7

Emissions calculations supporting Tables 4.1 through 4.3 for the new, modified, non-modified, and decommissioned sources associated with this project are provided in the following Appendices:

Appendix A: SO_2 Emission Calculations
Appendix B: NO_X Emission Calculations
Appendix C: $PM/PM_{10}/PM_{2.5}$ Emission Calculations
Appendix D: CO Emission Calculations
Appendix E: VOC Emission Calculations
Appendix F: Fugitive Emission Calculations
Appendix G: HAP Emission Calculations
Appendix H: PSD Netting Emissions

Appendix I: New and Modified Heater - SCR Cost Analysis
Appendix J: Detailed Ambient Air Quality Modeling Analysis

4.2 Emissions Calculation Basis

A discussion of the basis for the calculations provided in Appendices A through F is provided in the following. Note that only the sources that are new, modified or may see an incremental increase in ancillary emissions are listed. The emission calculation basis for all sources unaffected by the project is reflected in their corresponding construction permits and permit applications.

4.2.1 SO_2 Emissions

New and Modified Heaters
The new BSI Heater and the following modified heaters will fire refinery fuel gas.

- 581 Crude Heater
- 583 Vacuum Heater
- Naphtha Splitter Heater
- Heater HS
- #1HDS Heater

The fuel gas fired in these heaters will be required to meet the following refinery fuel gas H_2S limits per 40 CFR 60.102a(g)(1)(ii):

- 162 ppmvd (3-hr rolling average)
- 60 ppmvd (365-day rolling average)

To estimate SO_2 emissions, all H_2S in the fuel gas is assumed to be converted to SO_2. Hourly emissions are based on the 3-hour average and annual emissions are based on the 365-day average.

Coker Unit Flare
The Coker Unit Flare is an NSPS J compliant flare. As part of this permitting action SWRC will require the combustion of sweetened refinery fuel gas in the Coker Flare to accommodate potential periods when the refinery may have to operate in a fuel gas imbalance condition. The fuel gas fired in these heaters during non-process upset conditions will be required to meet the following refinery fuel gas H_2S limits per 40 CFR 60.102a(g)(1)(ii):

- 162 ppmvd (3-hr rolling average)
- 60 ppmvd (365-day rolling average)

To estimate SO_2 emissions, all H_2S in the fuel gas is assumed to be converted to SO_2. Hourly emissions are based on the 3-hour average and annual emissions are based on the 365-day average.

Non-Modified Heaters
These sources will be fired with refinery fuel gas. The refinery is currently required to limit fuel gas H_2S concentration to 0.1 grains/dscf at all fired heaters (re: Permit 30-145). This concentration is equivalent to 162 parts per million by volume, dry basis (ppmvd) and is the same concentration limit required in New Source Performance Standards: Subpart J (re: 40 CFR 60.104).

To estimate SO_2 emissions, all H_2S in the fuel gas is assumed to be converted to SO_2.

#2 Hydrogen Plant
In addition to fuel gas, the #2 Hydrogen Plant fires the gas from the Pressure Swing Adsorption (PSA) Unit used to purify the hydrogen produced in the plant. This PSA gas is required to have a very low concentration of H_2S for proper hydrogen plant operation and is estimated to have an H_2S concentration of 0.1 ppmvd. The #2 Hydrogen Plant heater is subject to NSPS Subpart Ja, and the fuel gas co-fired in the heater has the same sulfur content as the gas fired in the new and modified heaters described above. To estimate emissions, all H_2S in the fuel is assumed to be converted to SO_2.

#1 Hydrogen Plant
The #1 Hydrogen Plant fires only purchased natural gas (rather than refinery fuel gas) and PSA gas. The purchased natural gas is inherently low in H_2S and is estimated to have an H_2S concentration of 0.0025 grains per standard cubic foot. The PSA gas is required to have a very low concentration of H_2S for proper hydrogen plant operation and is estimated to have an H_2S concentration of 0.1 ppmvd. For emission calculation purposes it is conservatively estimated that the purchased natural gas and PSA gas is estimated to have an H_2S concentration of 0.1 ppmvd and all H_2S in the fuel is assumed to be converted to SO_2.

SRPs
SO_2 emissions from the SRPs are estimated based on engineering calculations derived from the exhaust flow rate and SO_2 concentrations permitted under MD-1381A2.

FCCU
SO_2 emissions from the FCCU are estimated based on engineering calculations derived from the FCCU exhaust flow rate and SO2 concentrations permitted under MD-10591.

LOLR
SO_2 emissions from the LOLR are deminimis as only sweetened fuels are dispensed at the loading rack and will not result in additional SO_2 emissions to be quantified.

New Emergency Air Compressor

SO_2 emissions from the new emergency air compressor are based on consuming #2 Diesel fuel with a sulfur content of 500 ppmw at maximum design operation for 500 hrs/yr.

4.2.2 NO_X Emissions

New BSI Heater

For the proposed 50 MMBtu/hr fuel gas-fired heater for the new BSI Unit, SWRC is proposing to control NO_X emissions using low-NO_X burner technology. NO_X emissions using this technology are estimated to be 0.030 lb/MMBtu. A Best Available Control Technology (BACT) analysis supporting the use of low-NO_X burners is provided in Appendix I.

Coker Unit Flare

NO_X emissions from the Coker Unit Flare are conservatively estimated assuming max flaring of 100 MMBtu/hr of sweetened refinery fuel gas and a NO_X emission factor of 0.068 lb/MM Btu taken from AP - 42 Emission Factor for Flares Table 13.5-1.

Existing Heaters

These combustion sources are operated using good combustion practice. SWRC will continue to operate these sources in compliance with the refinery's permit conditions. Emissions of NO_X from combustion sources associated with the Crude Optimization Project are estimated using the following emission factors:

Operating Unit	Emission Source	Emission Factor lb NOX/MM Btu
Coker	Coker Heater	0.033
#2 H2 Plant	#2 H2 Plant Heater	0.0100
581 Crude Unit	581 Crude Heater	0.030
583 Vacuum Unit	583 Vacuum Heater	0.030
Hydrocracker	Heater H1/H2	0.035
	Heater H3	0.035
	Heater H4	0.035
	Heater H5	0.035
780 FCCU	780 FCC Heater B3	0.230
	780 FCC Heater H2	0.230
#1 HDS	#1HDS Heater	0.035
781 Reformer	Naphtha Splitter Heater	0.035
	LEF Heater	0.035
	#1 Reformer Heater	0.035
	#2 Reformer Heater	0.035
	#3 Reformer Heater	0.035
	Stabilizer Heater	0.035
#4 HDS	H2 Heater (25-HT-101)	0.035
	H2 Heater (25-HT-102)	0.035
#1 H2 Plant	#1 H2 Plant Heater	0.065
Asphalt Loading	Asphalt Heater #1	0.230
	Asphalt Heater #2	0.230
#2 HDS	Charge Heater	0.035
#3 HDS	Charge Heater	0.035

SRPs

The SRP emissions of NO_X are estimated based on additional firing in the incinerator of 30 MMBtu/hr and a conservative vendor NO_X emission factor.

FCCU

NO_X emissions from the FCCU are estimated based on engineering calculations derived from the FCCU exhaust flow rate and NO_X concentrations permitted under MD-10591.

LOLR

The LOLR emissions of NO_X from the combustion of controlled vapors are estimated based on the LOLR throughput and vendor emission factor.

New Emergency Air Compressor

NOx emissions from the new emergency air compressor are based on operating at the 40 CFR Part 89.112 Tier III emission rate at maximum design operation for 500 hrs/yr.

4.2.3 PM/PM_{10}/$PM_{2.5}$ Emissions

New and Existing Heaters and Coker Unit Flare
The new BSI heater and the existing refinery heaters are fired exclusively with refinery fuel gas and/or purchased natural gas. The #2 Hydrogen Plant heater combusts refinery fuel gas and/or purchased natural gas and PSA purge gas which is a refinery fuel gas generated by the reforming process in the Hydrogen Plants. The #1 Hydrogen Plant heater combusts purchased natural gas and PSA purge gas but not refinery fuel gas. PM emissions from all of these fired sources are estimated by using filterable particulate emissions factors taken from AP-42[6]. Since the emissions result from the combustion of gaseous fuels, which results in fine particulate emissions, both PM_{10} and $PM_{2.5}$ emissions are assumed to be equal to the total PM emissions.

SRPs
The SRP emissions of PM/PM_{10}/$PM_{2.5}$ are estimated based on additional firing in the incinerator of 30 MMBtu/hr and filterable particulate emissions factors taken from AP-42.

FCCU
PM and PM_{10} emissions from the FCCU are estimated based on engineering calculations derived from the FCCU coke burn rate and an emission rate limit of 0.9 lb PM per thousand pounds of coke burn. $PM_{2.5}$ emissions are conservatively estimated based on the ratio of PM to $PM_{2.5}$ from stack testing in March 2011.

LOLR
Particulate emissions from the LOLR are deminimis as the LOLR flare is required to be smokeless.

New Emergency Air Compressor
PM emissions from the new emergency air compressor are based on operating at the 40 CFR Part 89.112 Tier III emission rate at maximum design operation for 500 hrs/yr.

4.2.4 CO Emissions

New and Existing Heaters and Coker Unit Flare
These units will be fired with refinery fuel gas and/or purchased natural gas and PSA gas (in the case of the #1 and #2 Hydrogen Plants) and will be operated using good combustion practices. Emissions of CO from these sources are estimated using the following emission factors from AP-42, Vendor Guarantees, and/or existing permit limits:

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6 AP-42, 5th ed, Table 1.4-2 (7/98 revision)

Operating Unit	Emission Source	Emission Factor lb CO/MMBtu
Coker	Coker Heater	0.040
BSI	BSI Heater	0.040
#2 H2 Plant	#2 H2 Plant Heater	0.020
581 Crude Unit	581 Crude Heater	0.040
583 Vacuum Unit	583 Vacuum Heater	0.040
Hydrocracker	Heater H1/H2	0.040
	Heater H3	0.040
	Heater H4	0.040
Hydrocracker	Heater H5	0.040
780 FCCU	780 FCC Heater B3	0.082
	780 FCC Heater H2	0.082
#1 HDS	#1HDS Heater	0.040
781 Reformer	Naphtha Splitter Heater	0.040
	LEF Heater	0.040
	#1 Reformer Heater	0.040
	#2 Reformer Heater	0.040
	#3 Reformer Heater	0.040
	Stabilizer Heater	0.040
#4 HDS	H2 Heater (25-HT-101)	0.040
	H2 Heater (25-HT-102)	0.040
Coker	Coker Unit flare	0.370
#1 H2 Plant	#1 H2 Plant Heater	0.082
Asphalt Loading	Asphalt Heater #1	0.082
	Asphalt Heater #2	0.082
#2 HDS	Charge Heater	0.040
#3 HDS	Charge Heater	0.040

SRPs

The SRP emissions of CO are estimated based on additional firing in the incinerator of 30 MMBtu/hr and a conservative vendor emission factor.

FCCU

CO emissions from the FCCU are estimated based on engineering calculations derived from the FCCU exhaust flow rate and CO concentration permitted under MD-10591.

LOLR

The LOLR emissions of CO from the combustion of controlled vapors are estimated based on the LOLR throughput and vendor emission factor.

New Emergency Air Compressor

CO emissions from the new emergency air compressor are based on operating at the 40 CFR Part 89.112 Tier III emission rate at maximum design operation for 500 hrs/yr.

4.2.5 VOC Emissions

New and Existing Heaters and Coker Unit Flare
These units will be fired with refinery fuel gas and/or purchased natural gas and PSA gas (in the case of the #1 and #2 Hydrogen Plants) and emissions are estimated by using emission factors taken from AP-42[7].

SRPs
The SRP emissions of VOC are estimated based on additional firing in the incinerator of 30 MMBtu/hr and VOC emission factors taken from AP-42.

FCCU
VOC emissions from the FCCU are estimated based on engineering calculations derived from historical FCCU stack testing results.

LOLR
The LOLR emissions of NO_X from the combustion of controlled vapors are estimated based on the LOLR throughput and vendor emission factor.

New Emergency Air Compressor
VOC emissions from the new emergency air compressor are based on operating at the 40 CFR Part 89.112 Tier I emission rate for HC at maximum design operation for 500 hrs/yr.

New BSI Product Tank and Existing Tanks
Emissions of VOC from storage tanks are estimated using the EPA's TANKS4.09d modeling software.

The emissions from the new storage tank were calculated using the tank parameters presented in Section 3.2.2. The product stored in the tank was conservatively assumed to be gasoline with a RVP of 6.

The incremental increase in VOC emissions associated with additional throughput for existing storage tanks is conservatively estimates based on historical working and breathing losses from crude, intermediate, and product storage tanks and the proposed increase in throughput post crude optimization.

Fugitive Emissions

7 AP-42, 5th ed, Table 1.4-2 (7/98 revision)

Fugitive emissions estimates are based on a conservative estimate of piping component to be added with this project and the Protocol for Equipment Leak Emission Estimates screening value correlations and AP-42[8]

8 Protocol for Equipment Leak Emission Estimates, (EPA-453/R-95-017, Table 2-10: Screening Value correlations, Table 2-2: Refinery Average Emission Factors) AP-42, 4 ed, (Fugitive Emission Factors, Table 9.1-2).

5.0 WAQS&R Chapter 6: Permitting Requirements

This section of the application addresses the permit application requirements presented in Chapter 6 of the WAQS&R.

5.1 WAQS&R Chapter 6, Section 2: Permit requirements for construction, modification, and operation

Chapter 6, Section 2(a)(i) states any person who plans to construct, modify or engage in the use of a facility which will cause an increase in the issuance of air contaminants shall obtain a construction permit before any actual work is begun on the facility. This application is intended to satisfy the requirements of Chapter 6, Section 2.

Chapter 6, Section 2(a)(ii) requires facilities subject to Chapter 6, Section 3 operating permit requirements to submit an application to the Division within twelve months of commencing operation. SWRC will revise and submit its Chapter 6, Section 3 permit application by the required date.

Chapter 6, Section 2(b) details the requirements for applying for a construction permit. These requirements include: submitting the application using forms supplied by the WDEQ/AQD; providing site information, plans, descriptions, specifications, design drawings of the sources; compiling an emissions inventory; and providing a construction schedule.

While SWRC believes the information provided in this application is sufficient for the Division to proceed with processing the application, detailed design information and the construction schedule have not yet been finalized at this time. At the Division's request, SWRC will provide this information when it becomes finalized.

Chapter 6, Section 2(c) states the requirements which must be met before a construction permit is issued. These requirements are detailed as follows.

5.1.1 WAQS&R Chapter 6, Section 2(c)(i): (Compliance with Applicable Rules & Regulations)

SWRC intends to comply with all rules and regulations of the WDEQ/AQD and with the intent of the Wyoming Environmental Quality Act.

5.1.2 WAQS&R Chapter 6, Section 2(c)(ii): (Attainment / Maintenance of Ambient Air Quality Requirements

Air dispersion modeling studies have been conducted to determine compliance with ambient air quality standards. The air quality analyses supporting this permit application were based upon the air dispersion modeling protocol as defined in 40 CFR 51 Appendix W, Guideline on Air Quality Models and the ***Wyoming***

Department of Environmental Quality/Air Quality Division Guidance for Conducting Near-Field Modeling Analyses for Major/PSD Sources (Revised January, 2010), hereafter referred to as the WDEQ-AQD Modeling Guidance.

A pre-modeling protocol was submitted to WDEQ-AQD on September 19, 2011. WDEQ-AQD provided comments to the pre-modeling protocol in an e-mail dated September 20, 2011 from Mr. Josh Nall – NSR Program Principal, Dispersion Modeling. The items discussed in the e-mail were agreed to be valid by SWRC and have been incorporated into this modeling analysis. A detailed discussion of the air dispersion modeling methodology and resulting analyses supporting this permit application is provided in Appendix J. A brief summary of these analyses and results are provided below.

Class I and Class II Area Significant Impact Analyses

Significant impact analyses estimate the ambient impacts from the proposed project and contemporaneous emissions increases and decreases, if applicable, for those pollutants with net emission increases above the Significant Impact Levels (SILs). The results of the significant impact analysis determine whether a cumulative impact analysis (including emissions from other nearby sources) must be performed. If the ambient impacts from the proposed project are less than the SIL for a particular pollutant and averaging period, then no additional modeling is required to meet Federal New Source Review (NSR) permitting requirements.

For the Class I significant impact analysis, all project related emissions increases and decreases, including those during the contemporaneous period, were modeled using a ring of receptors placed at 50km from the middle of the project sources. Maximum impacts at each receptor were compared to the Class I SIL for each applicable pollutant and averaging period. All pollutants and averaging periods showed results below the applicable Class I SILs. Therefore, no additional Class I analyses are required.

For the Class II significant impact analysis, all project related emissions increases and decreases, including those during the contemporaneous period, were modeled using the full base receptor grid. Maximum impacts at each receptor were compared to the Class II SIL for each pollutant and averaging period. Reduced grids of those receptors that showed maximum impacts above the respective SILs were produced for use in the cumulative impact analyses. The SO_2 annual averaging period, PM_{10} annual and 24-hr averaging periods, and $PM_{2.5}$ annual averaging period showed no receptors with maximum modeled concentrations over the respective SILs. Therefore, no further Class II analyses were required for these respective pollutant averaging periods.

Further detail and specific results of the Class I and II Significant Impact

Analyses can be found in Appendix J.

Class I and II Area Cumulative Impact Analyses

Cumulative impact analyses were performed to assess compliance with the applicable standard for any pollutant/averaging period for which the project results in significant impacts. These analyses include NAAQS/WAAQS and PSD Increment for Class I and II areas.

All pollutants and averaging periods that showed a significant impact were modeled using the reduced receptor grids as explained above. These results were compared to the applicable NAAQS/WAAQS standards. All pollutants and averaging times showed compliance with all applicable NAAQS/WAAQS standards, including background concentrations provided by WDEQ-AQD.

Any pollutant and averaging period combination that shows a significant impact is also required to show compliance with the applicable Class II increments. In the case of these analyses, all pollutants and averaging times showed concentrations below the increment during the NAAQS/WAAQS phase of modeling. Therefore, compliance with the Class II increments is shown, and no further analyses are required.

No pollutant and averaging period combination showed significance as compared to the Class I SILs at a distance of 50km in any direction. Therefore no comparison to the Class I increments is required.

Further detail and specific results of the Class I and II Area Cumulative Impact Analyses can be found in Appendix J.

WDEQ-AQD Inhalation Risk Assessment

An inhalation risk assessment for Hazardous Air Pollutants (HAP) from project related sources was performed. Per WDEQ-AQD guidance, a Tier 1 (screening level) analysis was performed to estimate the chronic carcinogenic risks for the project. The analysis followed the facility-specific assessment guidance developed by EPA as described in the document *Air Toxics Risk Assessment Reference Library, Volume 2, Facility Assessment*. The analysis used the AERMOD model and base receptor grid per additional WDEQ-AQD guidance. Taking into account the conservative nature of this analysis (assuming an individual is exposed to the maximum modeled concentration continuously for 70 years) and the results obtained from the analysis, it can be determined that the chronic carcinogenic risks from this project are within acceptable levels. Detailed methodology and results of this analysis can be found in Appendix J.

5.1.3 WAQS&R Chapter 6, Section 2(c)(iii): (Significant Deterioration of Existing Ambient Air)

Compliance with the Class I and Class II PSD increments are discussed in Section 5.1.2 above, and discussed in detail in Appendix J.

Additional impact analyses are required for PSD permit applications. The three types of additional impacts analyses are growth, soils and vegetation, and visibility.

Growth Analysis

Per the U.S. EPA Guidelines[9], a growth analysis is required only "if the project would result in a significant shift of population and associated activity into an area - that is, a population increase on the order of thousands of people." A temporary increase in the local population may occur only during the construction period of this project; however, the project will not result in a significant population shift or increase. The number of net new jobs in the community will not result in a significant shift of population. Therefore, a growth analysis is not required.

Soils and Vegetation Analysis

An analysis of soils and vegetation is included in Appendix J. The project is not expected to have an appreciable detrimental effect on soils and vegetation surrounding the project area.

Class I Area Impacts – Air Quality Related Values

A Class I PSD Area is defined as either:

- International park
- National wilderness area greater than 5,000 acres
- National memorial park greater than 5,000 acres
- National park greater than 6,000 acres

The nearest Class I area to SWRC is the Savage Run Wilderness Area, which is approximately 75 kilometers from the location of the project sources.

Per the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) guidance, Class I visibility and Air Quality Related Values (AQRV) analyses

9 U.S. EPA, *Draft New Source Review Workshop Manual. Prevention of Significant Deterioration and Nonattainment Area Permitting*, U.S. EPA, Office of Air Quality, October 1990. *Chapter D, Additional Impact Analyses.*

must be conducted if the sum of the PM_{10}, SO_2, and NO_X emission increases from the project, in tons per year (tpy) exceeds 10D, where D is the distance in kilometers from the source. A full Q/D analysis and request for determination of need for an analysis has been submitted by SWRC to WDEQ-AQD and was forwarded on to the appropriate Federal Land Managers (FLMs). It was determined, by all affected agencies, that no Class I AQRV impact will be required for this project.

5.1.4 WAQS&R Chapter 6, Section 2(c)(iv): (Location Standards)

The refinery is located in accordance with proper land use planning as determined by the State of Wyoming and Carbon County.

5.1.5 WAQS&R Chapter 6, Section 2(c)(v): (Best Available Control Technology (BACT) Evaluation)

This section of the WAQS&R requires the use of BACT with consideration of the economic reasonableness of reducing or eliminating the emissions resulting from new or modified sources. BACT is defined in 40 CFR 52.21(b)(12) of the PSD regulations as "..an emission limitation based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any…source…which on a case-by-case basis is determined to be achievable taking into account energy, environmental and economic impacts and other costs". For over 20 years it has been EPA's policy to require a "top-down" BACT analysis as described in EPA's October, 1990, Draft New Source Review Workshop Manual. Two key elements of a top-down analysis are that the most stringent control technologies must be considered, and a decision to require a lesser degree of emissions reduction must be based on an objective analysis of energy, environmental and economic impacts.

The five basic steps of a top-down BACT analysis are listed below:

Step 1: Identify potential control technologies

Step 2: Eliminate technically infeasible options

Step 3: Rank remaining control technologies by control effectiveness

Step 4: Evaluate the most effective controls and document results

Step 5: Select BACT

The first step is to identify potentially "available" control options for each emission unit triggering PSD, for each pollutant under review. Available options should consist of a comprehensive list of those technologies with a potentially practical application to the emission unit in question. The list should include lowest achievable emission rate (LAER) technologies, innovative technologies, and controls applied to similar source categories. For this analysis, the following sources were relied upon:

- EPA's New Source Review Website,
- U.S. EPA's RACT/BACT/LAER Clearinghouse (RBLC) Database,
- Various state air quality regulations and websites,
- Recent EPA Consent decrees within the refining industry,
- Control Technology Vendors,
- Technical Books and Articles (as specified in the references to this document), and
- Guidance Documents.

After identifying potential technologies, the second step is to eliminate technically infeasible options from further consideration. To be considered feasible, a technology must be both available and applicable. It is important, in this step, that the technical basis for eliminating a technology from further consideration be clearly documented based on physical, chemical, engineering, and source-specific factors related to safe and successful use of the controls.

The third step is to rank the technologies not eliminated in Step 2 in order of descending control effectiveness for each pollutant of concern. If the highest ranked technology is proposed as BACT, it is not necessary to perform any further technical or economic evaluation. Potential adverse impacts, however, must still be identified and evaluated.

The fourth step entails an evaluation of energy, environmental, and economic impacts for determining a final level of control. The evaluation begins with the most stringent control option and continues until a technology under consideration cannot be eliminated based on adverse energy, environmental, or economic impacts. The economic or cost-effectiveness" analysis is conducted in a manner consistent with EPA's OAQPS Control Cost Manual Fifth Edition (EPA 1996) and subsequent revisions. An important aspect of the top-down BACT methodology is the establishment of baseline emission levels that are used in calculating the cost-effectiveness of alternative control options. EPA's Draft New Source Review Workshop Manual states that baseline emissions should be a realistic upper bound estimate of emissions taking into account physical or operational constraints and historical operating data.

The fifth and final step is to select as BACT the most effective of the remaining technologies under consideration for each pollutant of concern.

BACT considerations for SO_2, CO, VOC, and NO_X emissions from the proposed new and modified sources follow.

5.1.5.1 SO_2 Emissions

New and Modified Heaters

New and modified heaters will be fired with refinery fuel gas and/or purchased natural gas and is required to meet the fuel gas provisions of NSPS Subpart Ja (re: 40 CFR 60.102a) as described in Section 4.2.1 of this application.

SWRC proposes that incorporating the fuel gas H_2S concentration limits of NSPS Subparts J and Ja be accepted as BACT for SO_2 emissions from the new and modified heaters. Therefore no further control considerations are required.

Coker Unit Flare

The Coker Unit Flare is a control device currently equipped with a FGR system. Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of FGR has been identified as BACT for refinery flares.

Additionally after this project, the Coker Unit flare gas will be required to meet the fuel gas provisions of NSPS Subpart Ja (re: 40 CFR 60.102a). SWRC proposes that incorporating the fuel gas H_2S concentration limits of NSPS Subparts Ja and use of FGR be accepted as BACT for SO_2 emissions from the Coker Unit Flare. Therefore no further control considerations are required.

New Emergency Air Compressor

SWRC proposes that incorporating the #2 Diesel fuel sulfur content limit of 500 ppmw and the operation of this emergency engine to no more than 500 hrs/yr be accepted as BACT for SO_2 emissions. Therefore no further control considerations are required.

5.1.5.2 CO Emissions

New and Modified Heaters

Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of only gaseous fuels and good combustion practices has been identified as BACT for CO for the new and modified heaters.

CO emission increases resulting from the new and modified heaters also require the consideration of a BACT analysis. The heaters will fire refinery fuel gas and/or purchased natural gas[10] to generate thermal energy necessary to indirectly heat process fluids. The heaters are inherently designed for complete combustion; this is accomplished by ensuring high combustion zone temperatures, sufficiently long residence times in the combustion zones and operating with excess oxygen. These are also the same combustion conditions necessary to minimize the formation of CO. Accordingly, SWRC proposes BACT for CO emissions from refinery fuel gas / purchased natural gas fired combustion sources is no additional control. SWRC proposes that use of good combustion practices to be accepted as BACT for CO emissions from the new and modified heaters. Therefore no further control considerations are required.

Coker Unit Flare

The Coker Unit Flare is a control device currently equipped with a FGR system. Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of FGR has been identified as BACT for refinery flares. SWRC proposes that use of FGR be accepted as BACT for CO emissions from the Coker Unit Flare. Therefore no further control considerations are required.

New Emergency Air Compressor

The new emergency air compressor will be installed and operated to comply with the exhaust emission standards of 40 CFR Part 89.112 for Tier III engines and limited in operation to no more than 500 hrs/yr. SWRC proposes this as BACT for the emergency engine and therefore no further control considerations are required.

5.1.5.3 VOC Emissions

New and Modified Heaters

Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of only gaseous fuels and good combustion practices has been identified as BACT for VOCs for the new and modified heaters.

VOC emission increases resulting from the new and modified heaters also require the consideration of a BACT analysis. The heaters will fire refinery fuel gas and/or purchased natural gas[11] to generate thermal energy necessary to indirectly heat process fluids. The heaters are inherently designed for complete combustion;

10 Note the #1 Hydrogen Plant heater combusts both purchased natural gas and PSA gas while the #2 Hydrogen Plant heater combusts purchased natural gas, refinery fuel gas, and PSA gas.
11 Note the #1 Hydrogen Plant heater combusts both purchased natural gas and PSA gas while the #2 Hydrogen Plant heater combusts purchased natural gas, refinery fuel gas, and PSA gas.

this is accomplished by ensuring high combustion zone temperatures, sufficiently long residence times in the combustion zones and operating with excess oxygen. These are also the same combustion conditions necessary to maximize the destruction of VOC. Accordingly, SWRC proposes that use of good combustion practices to be accepted as BACT for VOC emissions from the new and modified heaters. Therefore no further control considerations are required.

<u>Coker Unit Flare</u>
The Coker Unit Flare is a control device currently equipped with a FGR system. Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of FGR has been identified as BACT for refinery flares. SWRC proposes that use of FGR be accepted as BACT for VOC emissions from the Coker Unit Flare. Therefore no further control considerations are required.

<u>New Emergency Air Compressor</u>
The new emergency air compressor will be installed and operated to comply with the exhaust emission standards of 40 CFR Part 89.112 for Tier III engines and limited in operation to no more than 500 hrs/yr. SWRC proposes this as BACT for the emergency engine and therefore no further control considerations are required.

<u>New Fugitive Emission Sources</u>
Assessment of VOC controls is required only for the new fugitive emissions from the project. Fugitive emissions, by definition, are those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening. According to the New Source Review Workshop Manual, it is "unreasonable to expect that relatively small quantities of VOC emissions, caused by leaking valves at outside storage tanks…could be captured and vented to a stack." Therefore, the only control technology for fugitive valves is leak detection and repair.

The Refinery currently controls VOC fugitive component equipment leaks through a periodic leak detection and repair (LDAR) program. The approved leak detection and repair (LDAR) program is considered to be the Maximum Achievable Control Technology (MACT) under the Refinery MACT rule. Since MACT always equals or exceeds BACT, the LDAR program is selected as BACT at SWRC. In addition, regulatory guidance from states with a preponderance of the nation's refineries indicates the BACT for fugitive VOC emissions is an approved leak detection and repair program.

5.1.5.4 NO_X Emissions

Coker Unit Flare
The Coker Unit Flare is a control device currently equipped with a FGR system. Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the use of FGR has been identified as BACT for refinery flares. SWRC proposes that use of FGR be accepted as BACT for NOx emissions from the Coker Unit Flare. Therefore no further control considerations are required.

New Emergency Air Compressor
The new emergency air compressor will be installed and operated to comply with the exhaust emission standards of 40 CFR Part 89.112 for Tier III engines and limited in operation to no more than 500 hrs/yr. Additionally SWRC will meet the NO_x emission limit requirements of 40 CFR Part 60 Subpart IIII for an emergency stationary internal combustion engine. SWRC proposes this as BACT for the emergency engine and therefore no further control considerations are required.

New and Modified Heaters
SWRC is providing an analysis of the technical feasibility and cost effectiveness of NO_X controls for the new and modified sources associated with this project. The following is a top-down BACT evaluation for these sources.

Identification of Candidate NO_X Control Technologies
The first step in a top-down analysis is to identify the available control options. Based upon discussions with state and federal agencies, industry contacts, air pollution control equipment vendors and review of the EPA web site, the following NO_X control technologies have been identified for consideration for the new and modified heaters. These technologies are also ranked according to performance starting at the most stringent control level.

1. Selective Catalytic Reduction (SCR)
2. Selective Non-Catalytic Reduction (SNCR)
3. Ultra-Low NO_X Burners (ULNB)

In keeping with the top-down approach, the basic operation, technical feasibility, performance and advantages/disadvantages of the system that achieves the lowest emission rate will be discussed first. If proposed as BACT, the technical feasibility and associated impacts of the alternative controls will not be reviewed. If the lowest emitting scenario is not proposed as BACT, each subsequent control scenario will be evaluated starting at the next most stringent control level. BACT will be selected when a scenario cannot be dismissed due to technological, environmental, economic or energy related arguments.

Economic Impact – Cost Estimating Procedures
The cost estimating procedure used to evaluate the economic impact of alternative control technologies is described in this section.

Capital Costs
When available, actual installed cost data can be used to develop the Total Installed Capital Cost (TICC). If actual costs were not available, vendor supplied budgetary costs could be used. If neither is available, other cost estimating techniques are available. For this analysis, SWRC based the TICC for SCR on the estimation methodologies in the USEPA's Air Pollution Control Cost Manual - 6th Edition.

Annualized Costs
For this analysis, the annualized costs for capital equipment are based upon the Capital Recovery Cost (CRC) of the equipment. The CRC is the product of Capital Recovery Factor (CRF) multiplied by the TICC.

CRC = CRF x TICC
Where: $CRF = X(1+X)^n/(1+X)^n-1$
X = annual interest rate
n = equipment life

For all presented options, the CRF was based upon a 10 year equipment life and an average annual interest fraction of 0.1 which results in a CRF of 0.163.

The total annualized cost is the sum of the annualized CRC plus the annual operating costs for the equipment.

Cost Effectiveness
The economic impact incurred by the use of a pollution control alternative is measured as cost effectiveness. Cost effectiveness is the value obtained by dividing the annual tons of pollutant controlled into the annual cost. This results in a "dollar per ton" effectiveness value used in the cost effectiveness comparison.

5.1.5.4.1 New and Modified Heaters NO_X Control Cost Analysis

Comparison of NO_x Control Technologies and Application to Candidate Source

Most Stringent Control Level
The most stringent level of control is SCR, as described above for all new and modified heaters. EPA documentation states that, where applicable, Selective Catalytic Reduction (SCR) offers the highest percent reductions

of the available NO_x reduction techniques[12]. The SCR process involves the mixing of anhydrous or aqueous ammonia vapor with flue gas and passing the mixture through a catalytic reactor to reduce NO_X to N_2. Under optimal conditions, SCR can have a removal efficiency greater than 90%, although typical reduction efficiencies are less than 90%.

The most important factor affecting SCR efficiency is temperature. SCR can operate in a flue gas window ranging from 500 °F to 1100 °F according to EPA literature[13], although the optimum range for SCR to be effective is 625 °F to 700 °F[14]. Temperatures below the optimum decrease catalyst activity and allow NH_3 to slip through; above the optimum range, ammonia will oxidize to form additional NO_x. SCR efficiency is also largely dependent on the stoichiometric molar ratio of NH_3:NO_x; variation of the ideal 1:1 ratio to 0.5:1 ratio can reduce the removal efficiency to 50%[15].

<u>Economic Impacts</u>
The cost effectiveness calculation for installing a SCR unit on the new and modified heaters was based upon EPA's Air Pollution Cost Control Manual[16]. This analysis used EPA's "default" cost parameters and follows the example problem included in Section 2.5 of the manual with the following exceptions:

- The baseline or uncontrolled NO_x emission rate is defined as the existing burner, with its estimated emission rate in lb NO_x/MMBtu.
- A NO_x CEMS was also included in the direct capital cost.
- SCR catalyst cost of \$340/ft3 was obtained from a vendor supplied equipment quote for SCR installation (on the Fluid Catalytic Cracking Unit located at the SWRC).
- The cost of performance testing (initial and annual) was included.

Please refer to Appendix I for the cost effectiveness calculations. Table 5.1 - 5.6 summarize the cost effectiveness calculations for the SCR alternative for all new and modified heaters

12 Alternative Control Techniques Document NO$_X$ Emissions from Process Heaters (Revised), EPA-453/R-93-034.
13 EPA-453/R-93-034.
14 EPA-453/R-93-034 and Appendix.
15 EPA-453/R-93-034.
16 EPA Air Pollution Cost Control Manual, 6th ed, EPA 452/B-02-001, Section 4.2.

Table 5.1 Summary of Cost Effectiveness for SCR Alternative – 581 Crude Unit Heater

Direct Capital Cost (Equipment Cost)	$4,983,538	
Total Capital Investment (Total Installed Capital Cost)	$7,015,040	
Indirect Cost (Capital Recovery Cost)	$1,141,665	per year
Direct Annual Cost (Operating Cost)	$213,666	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$1,355,331	per year
NOx abated	20.4	tons per year
Cost Effectiveness	**$66,403**	**per ton NOx abated**

Table 5.2 Summary of Cost Effectiveness for SCR Alternative – 583 Vacuum Heater

Direct Capital Cost (Equipment Cost)	$1,934,770	
Total Capital Investment (Total Installed Capital Cost)	$2,723,441	
Indirect Cost (Capital Recovery Cost)	$443,227	per year
Direct Annual Cost (Operating Cost)	$84,318	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$527,545	per year
NOx abated	5.6	tons per year
Cost Effectiveness	**$93,804**	**per ton NOx abated**

Table 5.3 Summary of Cost Effectiveness for SCR Alternative – #1 HDS Heater

Direct Capital Cost (Equipment Cost)	$2,200,609	
Total Capital Investment (Total Installed Capital Cost)	$3,097,616	
Indirect Cost (Capital Recovery Cost)	$504,123	per year
Direct Annual Cost (Operating Cost)	$85,636	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$589,758	per year
NOx abated	3.7	tons per year
Cost Effectiveness	**$161,255**	**per ton NOx abated**

Table 5.4 Summary of Cost Effectiveness for SCR Alternative – Naphtha Splitter Heater

Direct Capital Cost (Equipment Cost)	$1,974,156	
Total Capital Investment (Total Installed Capital Cost)	$2,778,874	
Indirect Cost (Capital Recovery Cost)	$452,249	per year
Direct Annual Cost (Operating Cost)	$77,169	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$529,418	per year
NOx abated	5.1	tons per year
Cost Effectiveness	**$104,425**	**per ton NOx abated**

Table 5.5 Summary of Cost Effectiveness for SCR Alternative – Hydrocracker H5 Heater

Direct Capital Cost (Equipment Cost)	$1,613,539	
Total Capital Investment (Total Installed Capital Cost)	$2,271,269	
Indirect Cost (Capital Recovery Cost)	$369,639	per year
Direct Annual Cost (Operating Cost)	$65,450	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$435,089	per year
NOx abated	4.9	tons per year
Cost Effectiveness	**$88,495**	**per ton NOx abated**

Table 5.6 Summary of Cost Effectiveness for SCR Alternative – New BSI Heater

Direct Capital Cost (Equipment Cost)	$1,706,602	
Total Capital Investment (Total Installed Capital Cost)	$2,402,259	
Indirect Cost (Capital Recovery Cost)	$390,957	per year
Direct Annual Cost (Operating Cost)	$68,477	per year
Total Annual Cost (Capital Recovery Cost + Operating Cost)	$459,434	per year
NOx abated	4.4	tons per year
Cost Effectiveness	**$104,894**	**per ton NOx abated**

SWRC considers the cost effectiveness of the SCR alternative to be economically unreasonable. Therefore, the second most stringent control level will be considered.

Second Most Stringent Control Level

Selective Non-Catalytic Reduction (SNCR) is considered the second most stringent control level. SNCR is similar to SCR with the exception the ammonia is injected at a higher temperature (approximately 1,800°F) and a catalyst bed is not used to lower the activation energy of the reduction reaction. Typical NO_X reduction efficiencies range from 50% to 80% depending upon the residence time of the ammonia-flue gas mixture in the reaction temperature window.

If SNCR is applied to the candidate heaters, ammonia would be injected between the radiant heat transfer section and the convective heat transfer section. However, the flue gas temperature is not uniform across these flow regimes and the temperature continues to decrease rapidly through the downstream heat exchange zones. Both the temperature non-uniformity and the lack of residence time in the SNCR temperature window inhibit the reaction efficiency. In addition, if the temperature should exceed the desired temperature window, the ammonia will be oxidized to NO_X which will be counter-productive.

Because of the NO_X reduction performance uncertainty relating to the use of SNCR, SWRC discounts SNCR as technologically unsound for application with the new and modified heaters. The third most stringent control level will be considered next.

Third Most Stringent Control Level
Ultra-Low NO_X burners are considered the third most stringent level of control. These burners employ fuel and/or air staging, and may use flue gas recirculation. Gas recirculation is achieved through either external routing or internal recirculation within the flame envelope. Multiple combustion zones within the flame zone are employed. One typically operates under a fuel-rich condition and the other under a fuel-lean condition. The two zones are then mixed in a final burnout zone with low overall excess air to achieve NO_X reduction. Due to the use of fuel staging, air staging and flue gas recirculation, the burner flame envelope is significantly larger than for conventional burners.

SWRC utilizes Ultra-Low NOx burners in all of the modified heaters and also proposes to utilize Ultra-Low NOx burners in the new BSI Heater. Thus, SWRC is proposing the use of Ultra-Low NOx burners as BACT for NOx emissions from the new and modified heaters.

5.1.6 WAQS&R Chapter 6, Section 2(c)(vi): (Measurement of Emissions)

The refinery has provisions for measuring H_2S concentration in the refinery fuel gas which is fired in the new and existing heaters and boilers. The H_2S monitor was installed, certified and is maintained in accordance with Chapter 5, Section 2 of the WAQS&R. No new additional emissions monitoring is required for this project.

5.1.7 WAQS&R Chapter 6, Section 2(c)(vii): (Achievement of Performance Specified in Permit Application)

SWRC intends to comply with the performance specified in this application.

5.1.8 WAQS&R Chapter 6, Section 2(c)(viii): (Ambient Air Quality Standard Impact on Surrounding States)

As presented in Section 5.1.2, the facility will not adversely impact the WAAQS. Because the net emission increases resulting from this project are small and the facility is located close to the center of the state, the impact on surrounding states is considered minimal.

5.2 WAQS&R Chapter 6, Section 2(d): Use of Dispersion Techniques

No dispersion techniques or stack heights exceeding good engineering practice were used in the air dispersion modeling (Will be provided under separate cover).

5.3 WAQS&R Chapter 6, Section 3: Operating Permits

SWRC will submit to the Division a revision of its operating permit application incorporating provisions of this project within twelve months of commencing operation of the BSI Unit and associated modifications.

5.4 WAQS&R Chapter 6, Section 4: Prevention of Significant Deterioration

This section of the permit application addresses Prevention of Significant Deterioration (PSD) permitting requirements.

Per WAQS&R Chapter 6, Section 4, a petroleum refinery is a named facility. Because SWRC has the potential to emit regulated air pollutants in excess of 100 TPY, it is defined as a "Major Stationary Source". The facility is also located in a PSD (i.e. attainment) area for all pollutants. If a proposed increase in emissions from construction of a new source or modification of an existing source exceeds a PSD significance threshold, a PSD analysis is required.

For the initial test for PSD applicability, the emission increases from the project are compared to the PSD significance thresholds for each pollutant. Emission decreases are not evaluated at this stage. If the increase associated with the project is below the PSD significance threshold for a pollutant, PSD does not apply for that pollutant and no further analysis is required. If the PSD threshold is exceeded for one or more pollutants, the applicant may conduct a "netting analysis," which accounts for facility-wide emission increases and decreases of that pollutant over the five year contemporaneous period.

Table 5.7 presents the emission increases from new, modified, and non-modified sources associated with the Crude Oil Optimization Project. This table is a summary of the emissions information presented in the Tables of Section 4. Table 5.7 also compares the emission increases to the PSD significance levels.

Table 5.7 Project Emissions and PSD Significance Test

Sources	PM Emissions TPY	PM_{10} Emissions TPY	$PM_{2.5}$ Emissions TPY	SO_2 Emissions TPY	NO_X Emissions TPY	CO Emissions TPY	VOC Emissions TPY
Total New and Modified Sources	3.5	3.5	3.5	19.2	76.9	237.9	51.0
Total Non-Modified Sources	4.0	4.0	4.0	63.3	134.6	127.3	13.9
Total Project Emissions	7.5	7.5	7.5	82.5	211.5	365.2	65.0
PSD Significance Level	25	15	10	40	40	100	40
Exceed PSD Significance Level?	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**

As shown, the net emissions increases for $PM/PM_{10}/PM_{2.5}$ are less than the respective PSD significance levels. Therefore, PSD does not apply for these pollutants and a netting analysis is not required. The net emissions increases for SO_2, NO_X, CO, and VOC are greater than the respective PSD significance levels. PSD regulations allow the use of a netting analysis to determine if a "significant net emission increase" will occur as a result of a project. SWRC has performed the netting analysis in accordance with procedures specified in the PSD rules. A six-step procedure is used for determining the net emissions change and is summarized below.

1. Emission Increases From the Proposed Project - Determine the emission increases from the proposed project. If increases are significant, proceed; if not, the project is not subject to PSD review.

2. Contemporaneous Period - Determine the beginning and ending dates of the contemporaneous period as it relates to the proposed project.

3. Emissions Increases and Decreases - During the Contemporaneous Period - Determine which emissions units at the facility experienced (or will experience, including any proposed decreases resulting from the proposed project) a creditable increase or decrease in emissions during the contemporaneous period.

4. Creditable Emissions Changes - Determine which contemporaneous emissions changes are creditable.

5. Amount of the Emissions Increase and Decrease - Determine, on a pollutant-by-pollutant basis, the amount of each contemporaneous and creditable emissions increase and decrease.

6. PSD Review - Sum all contemporaneous and creditable increases and decreases with the emissions changes from the proposed project to determine if a significant net emissions increase will occur.

In order to perform a netting analysis, the contemporaneous periods must be determined. The term "contemporaneous period" is defined in the PSD regulation as the period that includes the five (5) years prior to initiating construction on a proposed modification, and the period between the initiation of construction and the initiation of operation of the new or altered equipment. The estimated date for initiating the Crude Oil Optimization Project is June 1, 2012. For purposes of contemporaneous period definition, the initial operation is scheduled for June 1, 2012. Therefore, the contemporaneous period for this project runs from June 3, 2007 through June 1, 2012.

Contemporaneous and creditable emissions increases included in the PSD netting analysis are based on current facility permits. The following table summarizes the contemporaneous and creditable emissions increase/decrease included in the project PSD netting analysis. Detailed emissions estimates and netting analysis are provided in Appendix H.

Table 5.8 Project Emissions and PSD Significance Netting Analysis

Sources	SO_2 Emissions TPY	NO_X Emissions TPY	CO Emissions TPY	VOC Emissions TPY
Total Project Emissions	82.5	211.5	365.2	64.9
Contemporaneous Emissions	21.8	15.7	117.6	64.5
Total Net Emissions	104.2	227.2	482.8	129.5
PSD Significance Level	40	40	100	40
Exceed PSD Significance Level?	**YES**	**YES**	**YES**	**YES**

As shown in the previous table the Crude Oil Optimization Project triggers PSD significance for SO_2, NO_X, CO, and VOC. Therefore, a full PSD review is required for these pollutants as a result of the modifications proposed in this plan approval. The PSD review requirements are summarized below:

- Apply Best Available Control Technology (BACT) for regulated pollutants emitted above PSD thresholds for all emissions units (see previous discussion in Section 5.1.5 of this report);
- Assess the ambient impact of emissions through the use of dispersion modeling (To be provided under separate cover); and
- Conduct additional impact assessments that analyze impairment to visibility, soils, and vegetation as a result of the modification, as well as impacts on Class I areas (To be provided under separate cover).

5.5 WAQS&R Chapter 6, Section 5: Permit Requirements for Construction and Modification of NESHAP Sources

The information required in Chapter 6, Section 5(a)(iii)(A)(II) is provided below:

Paragraphs (1) through (3): See Section 2 of the permit application (i.e. WDEQ/AQD forms).

Paragraph (4): The relevant standard is:

- 40 CFR 63 Subpart DDDDD (see Section 8.1.1 of the permit application)
- 40 CFR 63 Subpart CC (see Section 8.1.2 of the permit application)

Paragraph (5): The expected commencement date of construction/modification of this project is January 2012.

Paragraph (6): The expected construction/modification completion dates for the sources in this project are:

- 581 Crude Unit Heater: June 2012
- 583 Vacuum Unit Heater: June 2012
- #1 HDS Heater: June 2012
- Naphtha Splitter Heater: June 2012
- Hydrocracker Heater H5: June 2012
- BSI Heater: June 2013
- BSI Product Tank: June 2013

Paragraph (7): The anticipated initial start-up dates of these sources in this project are:

- 581 Crude Unit Heater: June 2012
- 583 Vacuum Unit Heater: June 2012
- #1 HDS Heater: June 2012
- Naphtha Splitter Heater: June 2012
- Hydrocracker Heater H5: June 2012
- BSI Heater: July 2013
- BSI Product Tank: July 2013

Paragraph (8): The types and estimated quantity of HAPs emitted by the sources is provided in Appendix G of the permit application.

6.0 New Source Performance Standards: WAQS&R Chapter 5, Section 2

Chapter 5, Section 2 of the WAQS&R addresses performance standards for affected facilities which commenced construction, reconstruction or modification after the applicability date of the standard. The Applicability and non-applicability of these standards as relating to this project are discussed in this section.

6.1 New Source Performance Standards Applicable to this Project

6.1.1 WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart Kb: Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction or Modification Commenced After July 23, 1984

The new storage tank will be subject to this rule because it will have a capacity greater than 151 cubic meters (949 bbl) and will store volatile organic liquid (VOL) with a vapor pressure greater than 5.2 kilopascals (kPa) (0.75 pounds per square inch (psi) but less than 76.6 kPa (11.1 psi). The tank will be larger than 1,589.874 cubic meters (10,000 bbl), so the exemption at 40 CFR 60.110b(d)(4) for vessels used for petroleum prior to custody transfer does not apply.

The new tank will comply with the requirements of Subpart Kb by the use of an external floating roof tank that meets the requirements of Section 60.112b(a)(2). All other existing tanks currently subject to Subpart Kb will continue to meet the requirements of 40 CFR 60, Subpart Kb.

6.1.2 WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart Ja: Standards of Performance for Petroleum Refineries

Fuel Gas Combustion Devices
This regulation is applicable to fuel gas combustion devices which commenced construction, modification or relocation after May 14, 2007. Therefore, the new and modified heaters and Coker Flare are required to meet the H_2S provisions of this Subpart (see Section 5.1.5.1). Note that the # 2 Hydrogen Plant, 583 Vacuum Heater, and the #11, #12, #13, and #14 Boilers are also required to meet the NSPS Ja standard. All other fuel gas combustion devices at the refinery are required to meet the fuel gas combustion device standards of WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart J: Standards of Performance for Petroleum Refineries.

6.1.3 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart IIII: Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

The new Emergency Air Compressor will be subject to the requirements for emergency stationary internal combustion engines under this subpart.

6.1.4 WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart GGGa: Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries for which Construction, Reconstruction, or Modification Commenced After November 7, 2006

All new piping components in existing units will be included in the refinery's LDAR program. All piping components in the new BSI Unit associated with this project will be subject to Subpart GGGa, and will be included in the refinery's LDAR program.

6.1.5 WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart QQQ: Standards of Performance for VOC Emissions from Petroleum Refinery Wastewater Systems

The project may require the installation of new drains, but will not involve any other modifications to the wastewater system. Wastewater from the new BSI Unit will drain to the refinery's existing wastewater treatment system. The new drains will be incorporated into the refinery's existing QQQ and BWON compliance management systems.

6.2 New Source Performance Standards Not Applicable to this Project

6.2.1 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart Dc: Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

There are no steam generating units in this source category associated with this project. The new and modified heaters are process heaters as defined in this subpart, and therefore the requirements of Subpart Db do not apply.

6.2.2 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart Db: Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units

There are no new, reconstructed, or modified sources in this source category associated with this Project. Although several of the boilers at the refinery are in this category, no boilers will be modified or reconstructed. The #1 and #2 Hydrogen Plant heaters are process heaters, not steam generating units, and will also not be modified or reconstructed as part of the project.

6.2.3 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart J: Standards of Performance for Petroleum Refineries and 40 CFR 60 Subpart Ja: Standards of Performance for Petroleum Refineries

As noted above, the fuel gas combustion devices associated with the Crude Oil Optimization Project will be subject to the relevant sections of Subparts J and Ja. The other provisions of these subparts do not apply, as described below.

<u>FCCU</u>
There are no new or modified FCCUs associated with this project.

<u>Claus Sulfur Recovery Plant (SRP)</u>
There are no new or modified SRPs associated with this project. The existing SRPs at the refinery are subject to 40 CFR 60 Subpart J and are affected sources per 40 CFR 63 Subpart UUU (i.e. Refinery MACT 2).

6.2.4 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart I: Standards of Performance for Hot Mix Asphalt Facilities

SWRC does not manufacture hot mix asphalt by heating and drying aggregate and mixing with asphalt cements per this standard. SWRC only manufactures asphalt cements. Therefore, SWRC is not an affected source under 40 CFR 60 Subpart I.

6.2.5 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart GG: Standards of Performance for Stationary Gas Turbines

There are no stationary gas turbines associated with this project.

6.2.6 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart UU: Standards of Performance for Asphalt Processing and Asphalt Roofing Manufacture

SWRC does not process asphalt or manufacture asphalt roofing materials per this standard.

6.2.7 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart XX: Standards of Performance for Bulk Gasoline Terminals

This project does not have any XX sources associated with it. Note Subpart XX is not directly applicable to SWRC. However, certain provisions of 40 CFR 60 Subpart XX are incorporated by reference via SWRC's applicability to 40 CFR 63 Subpart CC.

6.2.8 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart III: Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI Air Oxidization Processes)

There are no processes regulated by this standard associated with this project.

6.2.9 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart KKK: Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants

There are no processes regulated by this standard associated with this project.

6.2.10 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart LLL: Standards of Performance for Onshore Natural Gas Processing: SO_2 Emissions

Equipment associated with this project only process refinery fuel gas not natural gas per the definition in this rule. Therefore, the provisions of this rule do not apply to this project.

6.2.11 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart NNN: Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations

There are no processes regulated by this standard associated with this project.

6.2.12 WAQS&R Chapter 5, Section 2 – 40 CFR 60 Subpart RRR: Standards of Performance for Volatile Organic Compound Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes

There are no SOCMI reactor processes associated with this project. Therefore, the provisions of this rule do not apply to this project.

6.2.13 WAQS&R Chapter 5, Section 2 – 40 CFR 60.18(b): General Control Device Requirements (Flares)

There are no sources regulated by this standard associated with this project.

6.2.14 WAQS&R Chapter 5, Section 2 – 40 CFR 60, Subpart GGG: Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries

The BSI Unit will commence construction after November 7, 2006. Therefore the new BSI Unit fugitive components will be subject to NSPS GGGa. The new fugitive emission components in existing units will not trigger NSPS reconstruction thresholds and will not be subject to NSPS GGGa.

7.0 40 CFR 61 (NESHAP)

This section addresses the national emissions standards for hazardous air pollutants. The applicability and non-applicability of these standards as relating to this project are discussed in this section.

7.1 NESHAP Standards Applicable to this Project

7.1.1 40 CFR 61 Subpart M: National Emission Standards for Asbestos

This project may involve the removal of asbestos, therefore the provisions of this standard apply to SWRC. SWRC has an ongoing program to manage asbestos in accordance with this standard.

7.1.2 40 CFR 61 Subpart FF: National Emission Standards for Benzene Waste Operations (BWON)

The provisions of this standard apply to SWRC. Streams from the new unit and associated modifications will be analyzed and included in the Refinery's BWON program as applicable.

7.2 NESHAP Standards Not Applicable to this Project

7.2.1 40 CFR 61 Subpart J: National Emission Standards for Equipment Leaks (Fugitive Emission Sources) of Benzene

The provisions of this subpart are not applicable because there are no streams in benzene service associated with this project.

7.2.2 40 CFR 61 Subpart V: National Emission Standards for Equipment Leaks (Fugitive Emission Sources)

The provisions of this subpart are not applicable because there are no streams in VHAP service associated with this project.

7.2.3 40 CFR 61 Subpart Y: National Emission Standards for Benzene Emissions from Benzene Storage Vessels

The provisions of this subpart are not applicable because there are no benzene storage vessels associated with this project.

7.2.4 40 CFR 61 Subpart BB: National Emission Standards for Benzene Emissions from Benzene Transfer Operations

The provisions of this subpart are not applicable because there are no benzene transfer operations associated with this project.

8.0 40 CFR 63 (MACT) WAQS&R Chapter 5, Section 3

Chapter 5, Section 3 of the WAQS&R addresses the national emissions standards for hazardous air pollutants for affected facilities. The applicability and non-applicability of these standards as relating to this project are discussed in this section.

8.1 MACT Standards Applicable to this Project

8.1.1 40 CFR 63 Subpart DDDDD - National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters

40 CFR 63 Subpart DDDDD (Heater / Boiler MACT) is applicable to SWRC. On June 14, 2007, EPA vacated the Heater/Boiler MACT rule. However, the State of Wyoming adopted this rule by reference into the WAQS&R. Additionally, the EPA has since re-published and then delayed proposed new regulations for this Subpart. Therefore, this rule is applicable to the new and modified heaters at the state level, and the hydrogen plants and boilers are already subject to this subpart.

8.1.2 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart CC - National Emission Standards for Hazardous Air Pollutants From Petroleum Refineries

The storage vessel, equipment leak, miscellaneous process vent, gasoline loading rack and wastewater provisions of 40 CFR 63 Subpart CC are applicable to SWRC.

Some new fugitive components may be subject to the requirements of Subpart CC. These components will be incorporated into the refinery's LDAR program.

Wastewater streams associated with the project may also be subject to the Subpart CC standards. As applicable, these streams will comply with the applicable requirements of 40 CFR Part 60, Subpart QQQ and 40 CFR Part 61, Subpart FF.

The new BSI Product Tank will be a Group 1 storage vessel subject to the requirements of Subpart CC. The tank will be designed to comply with the requirements of 40 CFR Part 63 Subpart G, incorporated by reference.

There will be no new miscellaneous process vents associated with the proposed project.

8.1.3 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart ZZZZ - National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

A new or reconstructed emergency or limited use stationary RICE with a site rating of less than or equal to 500 brake HP located at a major source of HAP emissions must meet the requirements of this part by meeting the requirements of 40 CFR Part 60 Subpart IIII for compression ignition engines. As previously identified, the New Emergency Air Compressor will comply with the applicable provisions of 40 CFR Part 60 Subpart III for emergency stationary internal combustion engines. No further requirements apply for such engines under this part.

8.1.4 WAQS&R Chapter 5, Section 3 –40 CFR 63 Subpart GGGGG - National Emission Standards for Hazardous Air Pollutants: Site Remediation

40 CFR 63 Subpart GGGGG (Site Remediation MACT) is applicable to the refinery because site remediation is conducted. There is a potential for contaminated soils to be excavated in conjunction with this project but these activities are expected to be exempt from this subpart because 40 CFR 63.7881(b)(3) exempts site remediation performed under a Resource Conservation and Recovery Act (RCRA) corrective action. SWRC will follow

applicable requirements of the Site Remediation MACT for any remediation associated with this project that is not performed under a RCRA corrective action.

8.2 MACT Standards Not Applicable to this Project

8.2.1 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart F - National Emission Standards for Organic Hazardous Air Pollutants From the Synthetic Organic Chemical Manufacturing Industry

40 CFR 63 Subpart F is not applicable to SWRC.

8.2.2 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart G - National Emission Standards for Organic Hazardous Air Pollutants From the Synthetic Organic Chemical Manufacturing Industry for Process Vents, Storage Vessels, Transfer Operations, and Wastewater

40 CFR 63 Subpart G is not directly applicable to project. However portions of 40 CFR 63 Subpart G, as incorporated by reference via 40 CFR 63 Subpart CC, are applicable to SWRC.

8.2.3 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart H - National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks

40 CFR 63 Subpart H is not applicable to this project. Equipment leak provisions for this project and SWRC are incorporated by NSPS and MACT Subpart CC.

8.2.4 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart Q - National Emission Standards for Hazardous Air Pollutants for Industrial Process Cooling Towers

40 CFR 63 Subpart Q is not applicable to the SWRC because SWRC does not use chromium based water treatment chemicals.

8.2.5 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart R - National Emission Standards for Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)

40 CFR 63 Subpart R is not directly applicable to this project. However portions of 40 CFR 63 Subpart R, as incorporated by reference via 40 CFR 63 Subpart CC, are applicable to SWRC.

8.2.6 40 CFR 63 Subpart LLLLL - National Emission Standards for Hazardous Air Pollutants: Asphalt Processing and Asphalt Roofing Manufacturing

40 CFR 63 Subpart LLLLL (Asphalt Processing MACT) is not applicable to SWRC because this facility is not engaged in the preparation of asphalt flux as defined in 40 CFR 63.8698.

8.2.7 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart UUU - National Emission Standards for Hazardous Air Pollutants for Petroleum Refineries: Catalytic Cracking Units, Catalytic Reforming Units, and Sulfur Recovery Units

The FCCU regenerator vent, catalytic reforming unit vent and sulfur recovery unit vent provisions of 40 CFR 63 Subpart UUU are currently applicable to SWRC. There are no new affected Subpart UUU sources associated with this project.

8.2.8 WAQS&R Chapter 5, Section 3 – 40 CFR 63 Subpart EEEE - National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)

There are no Organic Liquid Distribution affected sources at SWRC or associated with this project. Therefore 40 CFR 63 Subpart EEEE is not applicable to SWRC.

9.0 40 CFR 64 - Compliance Assurance Monitoring (CAM) for Major Stationary Sources

This project has no CAM applicable sources associated with it.

10.0 40 CFR 68 - Chemical Accident Prevention Provisions

The chemical accident prevention provisions are applicable to SWRC. SWRC will include any necessary changes to its Risk Management Plan (RMP) in conjunction with this project.

11.0 40 CFR 82 – Protection of Stratospheric Ozone

The provisions of 40 CFR 82 are applicable to SWRC. SWRC uses licensed contractors to perform maintenance on equipment with Ozone depleting substances in accordance with this standard.

APPENDICES

Appendix A - SO_2 Emission Calculations

Appendix A
SO2 Emissions Calculations

Fuel Gas Fired Heaters:

Assume (nat. gas):	4	ppmv = H2S content of purchased natural gas
	1000	Btu/scf = Natural Gas Heat Content
Assume (J fuel gas):	162	ppmv = H2S content of fuel gas (3-hr)
	1160	Btu/scf = Estimated Fuel Gas Heat Content (HHV)
Assume (Ja fuel gas):	60	ppmv = H2S content of fuel gas (annual)
	1160	Btu/scf = Estimated Fuel Gas Heat Content (HHV)
Assume (PSA gas):	0.1	ppmv = H2S content of PSA gas
	246	Btu/scf = PSA Gas Heat Content

Calculation: SO2 Emissions = (__Btu/hr) x (scf/1160 Btu) x (____ppmv H2S/1000000) x (64 lb SO2)/(379.6 ft3/lb mol)

Operating Unit	Emission Source	Firing Rate (MMBtu/hr)	SO2 (Proposed)	
			lb/hr	TPY
Coker	Coker Heater	145.0	3.4	5.5
BSI	BSI Heater	50.0	0.4	1.9
#2 H2 Plant	#2 H2 Plant Heater	288.0	1.3	5.6
581 Crude Unit	581 Crude Heater	233.0	5.5	8.9
583 Vacuum Unit	583 Vacuum Heater	64.2	1.5	2.5
Hydrocracker	Heater H1/H2	38.0	0.9	1.5
	Heater H3	56.0	1.3	2.1
	Heater H4	57.0	1.3	2.2
	Heater H5	44.9	1.1	1.7
780 FCCU	780 FCC Heater B3	10.0	0.2	0.4
	780 FCC Heater H2	19.4	0.5	0.7
#1 HDS	#1HDS Heater	33.4	0.8	1.3
781 Reformer	Naphtha Splitter Heater	46.3	1.1	1.8
	LEF Heater	24.0	0.6	0.9
	#1 Reformer Heater	44.6	1.1	1.7
	#2 Reformer Heater	74.8	1.8	2.9
	#3 Reformer Heater	22.4	0.5	0.9
	Stabilizer Heater	11.1	0.3	0.4
#4 HDS	H2 Heater (25-HT-101)	22.0	0.5	0.8
	H2 Heater (25-HT-102)	24.0	0.6	0.9
Coker	Coker Unit flare	100.0	2.4	3.8
#1 H2 Plant	#1 H2 Plant Heater	288.0	0.1	0.5
Asphalt Loading	Asphalt Heater #1	8.0	0.2	0.3
#2 HDS	Charge Heater	28.0	0.7	1.1
#3 HDS	Charge Heater	18.0	0.4	0.7
Total			28.3	50.9

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SRP
Combined Emissions from #1, #2 and #3 TGTU

Permit MD-1381A2
250 ppm SO2 (dry, 0% O2), NSPS Subpart J

Basis: 32.2 lb/hr SO2 emissions
Calculation: 84.6 TPY SO2 emissions

Operating Unit	Emission Source	SO2 (Proposed)	
		lb/hr	TPY
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	32.2	84.6

FCCU

Basis: 24.9 ppm SO2 (dry, 0% O2, annual average)
50.0 ppm SO2 (dry, 0% O2, 7-day average)

Operating Unit	Emission Source	SO2 (Proposed)	
		lb/hr	TPY
780 FCCU	780 FCCU Regenerator	26.5	57.8

LOLR
SO2 increase from Light Oil Loading Rack / Flare

Emissions are deminimis - only sweetened fuels are dispensed

New Emergency Air Compressor
Hours of operation: 500 hrs/year
20.8 days/year

SO2

0.353 lb/HP-hr
500 ppm S in #2 Diesel

Calculation: SO2 Emissions = (__BHP) x (___lb/HP-hr) x (500/1000000) x (64 lb SO2/32 lb-S)

Operating Unit	Emission Source	Engine Power (BHP)	SO2	
			lb/hr	TPY
Boilerhouse	New Emergency Air Compressor	400	0.1	<0.1

Note: 1 Emission factors from 40 CFR Part 89.112 for Tier III engines

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Appendix B - NO_X Emission Calculations

Appendix B
NOx Emissions Calculations

New Heaters with Low NOx Burners:

Emission Factor	0.030	lb NOx/MM Btu

Existing Heaters with Low NOx Burners:

Emission Factor	0.035	lb NOx/MM Btu

H2 Plant with Low NOx Burners:

Emission Factor	0.065	lb NOx/MM Btu

SRU Incinerator Emissions Factor

Emission Factor	0.07	lb NOx/MM Btu

AP - 42 Emission Factor for Cat Ox

Emission Factor	0.098	lb NOx/MM Btu

AP - 42 Emission Factor for Flares (Table 13.5-1)

Emission Factor	0.068	lb NOx/MM Btu

SCR Performance

90% reduction	0.100	

Existing WAQS&R Gas Fired Heaters

Emission Factor	0.23	lb NOx/MM Btu

MD-976 NOx Factor

Emission Factor	0.04	lb NOx/MM Btu

New WAQS&R Gas Fired Heaters

Emission Factor	0.20	lb NOx/MM Btu

HC Unit Heaters

Emission Factor	0.07	lb NOx/MM Btu

Coker Heater Factor

Emission Factor	0.033	lb NOx/MM Btu

Calculation: NOx Emissions = (___ MMBtu/hr)x(____ lb NOx/MMBtu)

Operating Unit	Emission Source	Firing Rate (MMBtu/hr)	Emission Factor lb NOx/MM Btu	NOx (Proposed) lb/hr	TPY
Coker	Coker Heater	145.0	0.033	4.8	21.0
BSI	BSI Heater	50.0	0.030	1.5	6.6
#2 H2 Plant	#2 H2 Plant Heater	288.0	0.0100	2.9	12.6
581 Crude Unit	581 Crude Heater	233.0	0.030	7.0	30.6
583 Vacuum Unit	583 Vacuum Heater	64.2	0.030	1.9	8.4
Hydrocracker	Heater H1/H2	38.0	0.035	1.3	5.8
	Heater H3	56.0	0.035	2.0	8.6
	Heater H4	57.0	0.035	2.0	8.7
	Heater H5	44.9	0.035	1.6	6.9
780 FCCU	780 FCC Heater B3	10.0	0.230	2.3	10.1
	780 FCC Heater H2	19.4	0.230	4.5	19.5
#1 HDS	#1HDS Heater	33.4	0.035	1.2	5.1
781 Reformer	Naphtha Splitter Heater	46.3	0.035	1.6	7.1
	LEF Heater	24.0	0.035	0.8	3.7
	#1 Reformer Heater	44.6	0.035	1.6	6.8
	#2 Reformer Heater	74.8	0.035	2.6	11.5
	#3 Reformer Heater	22.4	0.035	0.8	3.4
	Stabilizer Heater	11.1	0.035	0.4	1.7
#4 HDS	H2 Heater (25-HT-101)	22.0	0.035	0.8	3.4
	H2 Heater (25-HT-102)	24.0	0.035	0.8	3.7
Coker	Coker Unit flare	100.0	0.068	6.8	29.8
#1 H2 Plant	#1 H2 Plant Heater	288.0	0.065	18.7	82.0
Asphalt Loading	Asphalt Heater #1	8.0	0.230	1.8	8.1
#2 HDS	Charge Heater	28.0	0.035	1.0	4.3
#3 HDS	Charge Heater	18.0	0.035	0.6	2.8
Total				71.3	312.1

SRP
Combined Emissions from #1, #2 and #3 TGTU Permit MD-1381A2
Basis: 30.0 MM Btu/hr
0.07 lb NOx / MM Btu
Calculation: lb/hr NOx = (30.0 MM Btu/hr) x (0.07 lb NOx/MM Btu)

Operating Unit	Emission Source	NOx (Proposed)	
		lb/hr	TPY
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	2.1	9.2

FCCU

Basis: 40.0 ppm NOx (dry, 0% O2, annual average)
80.0 ppm NOx (dry, 0% O2, 7-day average)

Operating Unit	Emission Source	NOx (Proposed)	
		lb/hr	TPY
780 FCCU	780 FCCU Regenerator	30.5	66.6

LOLR
NOx increase from Light Oil Loading Rack / Flare

Basis:

Facility Throughput:	M gpy
Gasoline	50000

Emission Factor 4.0 mg NOx/l Source: John Zink estimate
Emission Factor 0.0334 lb NOx/M gal Source: John Zink estimate

Assume: Heat release from the combustion of distillate fuel oil is deminimis

Calculation: NOx Emissions = (____ gal/hr)/(_____ lb NOx/M gal)

Operating Unit	Emission Source	NOx	
		lb/hr	TPY
Light Oil Loading	Loading Rack Flare	0.19	0.8

New Emergency Air Compressor
Hours of operation: 500 hrs/year
20.8 days/year

NOx

Calculation: NOx Emissions = (___ BHP)x(___ g/BHP)

Operating Unit	Emission Source	Engine Power (BHP)	Emission Factor (g/BHP-hr) (Note: 1)	NOx	
				lb/hr	TPY
Boilerhouse	New Emergency Air Compressor	400	3.0	2.65	0.66

Note: 1 Emission factors from 40 CFR Part 89.112 for Tier III engines

SBG/abg

Appendix C – PM/PM_{10}/$PM_{2.5}$ Emission Calculations

Appendix C
Particulate Matter Emissions Calculations

Fuel Gas Fired Heaters:

Basis:

1.9	lb-PM / MMscf (AP-42, 5th Edition, Table 1.4-2, Filterable PM)
0.0019	lb-PM / MM Btu, 1020 Btu/scf (AP-42, 5th Edition, Table 1.4-2)

Calculation:

PM Emissions = (___ MMBtu/hr)x(____ lb PM/MMBtu)

Operating Unit	Emission Source	Firing Rate (MMBtu/hr)	PM (Proposed) lb/hr	PM (Proposed) TPY
Coker	Coker Heater	145.0	0.3	1.2
BSI	BSI Heater	50.0	<0.1	0.4
#2 H2 Plant	#2 H2 Plant Heater	288.0	0.5	2.3
581 Crude Unit	581 Crude Heater	233	0.4	1.9
583 Vacuum Unit	583 Vacuum Heater	64.2	0.1	0.5
Hydrocracker	Heater H1/H2	38	<0.1	0.3
	Heater H3	58	0.1	0.5
	Heater H4	57	0.1	0.5
Hydrocracker	Heater H5	44.9	<0.1	0.4
780 FCCU	780 FCC Heater B3	10	<0.1	<0.1
	780 FCC Heater H2	19.4	<0.1	0.2
#1 HDS	#1HDS Heater	33.4	<0.1	0.3
781 Reformer	Naphtha Splitter Heater	46.3	<0.1	0.4
	LEF Heater	24.0	<0.1	0.2
	#1 Reformer Heater	44.6	<0.1	0.4
	#2 Reformer Heater	74.8	0.1	0.6
	#3 Reformer Heater	22.4	<0.1	0.2
	Stabilizer Heater	11.1	<0.1	<0.1
#4 HDS	H2 Heater (25-HT-101)	22.0	<0.1	0.2
	H2 Heater (25-HT-102)	24.0	<0.1	0.2
Coker	Coker Unit flare	100.0	0.2	0.8
#1 H2 Plant	#1 H2 Plant Heater	288.0	0.5	2.3
Asphalt Loading	Asphalt Heater #1	8.0	<0.1	<0.1
#2 HDS	Charge Heater	28.0	<0.1	0.2
#3 HDS	Charge Heater	18.0	<0.1	0.1
Total			3.3	14.3

SRP

Combined Emissions from #1, #2 and #3 TGTU

Proposed maximum emission rates:

Basis: 30.0 MM Btu/hr

0.0019 lb PM / MM Btu

Calculation: lb/hr PM = (13.2 MM Btu/hr) x (0.0019 lb PM/MM Btu)

Operating Unit	Emission Source	PM (Proposed)	
		lb/hr	TPY
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	0.056	0.24

FCCU

Basis: 0.9 lb PM / 1000 lb coke burn (NSPS Subpart J)

17877.2 lb / hr coke burn

Calculation: lb/hr PM = (______ lb / hr coke burn) x (____ lb PM / 1000 lb coke burn)

Operating Unit	Emission Source	PM (Proposed)	
		lb/hr	TPY
780 FCCU	760 FCCU Regenerator	16.1	70.5

PM = non sulfate particulate matter per EPA reference method 5F

LOLR

Contemporaneous PM increase from Light Oil Loading Rack / Flare

Emissions are deminimis - LOLR flare is required to be smokeless

New Emergency Air Compressor

Hours of operation: 500 hrs/year

20.8 days/year

PM

Calculation: PM Emissions = (___ BHP)x(___ g/BHP)

Operating Unit	Emission Source	Engine Power (BHP)	Emission Factor (g/BHP-hr) (Note: 1)	PM	
				lb/hr	TPY
Boilerhouse	New Emergency Air Compressor	400	0.15	0.13	0.03

Note: 1 Emission factors from 40 CFR Part 89.112 for Tier III engines

SBG/sbg

Appendix D - CO Emission Calculations

Appendix D
CO Emissions Calculations

Fuel Gas Fired Heaters:

Basis:
Existing Heaters with Conventional / Low NOx Burners
84 lb-CO / MMscf (AP-42, 5th Edition, Table 1.4-1)
0.082 lb-CO / MM Btu, 1020 Btu/scf (AP-42, 5th Edition, Table 1.4-1)

Heaters with Low NOx Burner Retrofits / New Heaters
0.040 lb-CO / MM Btu (Burner Vendor Estimate)

#2 H2 Plant
0.020 lb-CO / MM Btu (Burner Vendor Estimate)

Flares
0.370 lb-CO / MM Btu (AP-42 Table 13.5-1)

Then: CO emissions = (___ MMBtu/hr) x (____ lb-CO / MM Btu)

Operating Unit	Emission Source	Firing Rate (MMBtu/hr)	Emission Factor lb CO/MM Btu	CO (Estimated) lb/hr	TPY
Coker	Coker Heater	145.0	0.040	5.8	25.4
BSI	BSI Heater	50.0	0.040	2.0	8.8
#2 H2 Plant	#2 H2 Plant Heater	288.0	0.020	5.8	25.2
581 Crude Unit	581 Crude Heater	233.0	0.040	9.3	40.8
583 Vacuum Unit	583 Vacuum Heater	64.2	0.040	2.6	11.2
Hydrocracker	Heater H1/H2	38.0	0.040	1.5	6.7
	Heater H3	56.0	0.040	2.2	9.8
	Heater H4	57.0	0.040	2.3	10.0
Hydrocracker	Heater H5	44.9	0.040	1.8	7.9
780 FCCU	780 FCC Heater B3	10.0	0.082	0.8	3.6
	780 FCC Heater H2	19.4	0.082	1.6	7.0
#1 HDS	#1HDS Heater	33.4	0.040	1.3	5.9
781 Reformer	Naphtha Splitter Heater	46.3	0.040	1.9	8.1
	LEF Heater	24.0	0.040	1.0	4.2
	#1 Reformer Heater	44.6	0.040	1.8	7.8
	#2 Reformer Heater	74.8	0.040	3.0	13.1
	#3 Reformer Heater	22.4	0.040	0.9	3.9
	Stabilizer Heater	11.1	0.040	0.4	1.9
#4 HDS	H2 Heater (25-HT-101)	22.0	0.040	0.9	3.9
	H2 Heater (25-HT-102)	24.0	0.040	1.0	4.2
Coker	Coker Unit flare	100.0	0.370	37.0	162.1
#1 H2 Plant	#1 H2 Plant Heater	288.0	0.082	23.7	103.9
Asphalt Loading	Asphalt Heater #1	8.0	0.082	0.7	2.9
#2 HDS	Charge Heater	28.0	0.040	1.1	4.9
#3 HDS	Charge Heater	18.0	0.040	0.7	3.2
Total				111.0	486.3

SRP

Combined Emissions from #1, #2 and #3 TGTU

30.0 MM Btu/hr

0.300 lb-CO / MM Btu (Ortloff Estimate)

Then: CO emissions = (___ MMBtu/hr) x (0.082 lb-CO / MM Btu)

Operating Unit	Emission Source	CO (Estimated)	
		lb/hr	TPY
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	9.0	39.4

FCCU

Basis: 500.0 ppm CO (dry, 0% O2, hourly average)

Operating Unit	Emission Source	CO (Estimated)	
		lb/hr	TPY
780 FCCU	780 FCCU Regenerator	115.1	504.0

LOLR

Contemporaneous CO increase from Light Oil Loading Rack / Flare

Basis:

Facility Throughput:	M gpy
Gasoline	50000

Emission Factor 10.0 mg CO/l Source: John Zink estimate

Emission Factor 0.0834 lb CO/M gal Source: John Zink estimate

Assume: Heat release from the combustion of distillate fuel oil is deminimis

Calculation: CO Emissions = (___ gal/hr)/(____ lb CO/M gal)

Operating Unit	Emission Source	CO	
		lb/hr	TPY
Light Oil Loading	Loading Rack Flare	0.5	2.09

New Emergency Air Compressor
Hours of operation: 500 hrs/year
20.8 days/year

CO

Calculation: CO Emissions = (___ BHP)x(____ g/BHP)

Operating Unit	Emission Source	Engine Power (BHP)	Emission Factor (g/BHP-hr) (Note: 1)	CO (Estimated)	
				lb/hr	TPY
Boilerhouse	New Emergency Air Compressor	400	2.60	2.29	0.57

Note: 1 Emission factors from 40 CFR Part 89.112 for Tier III engines

SBG/sbg

Appendix E - VOC Emission Calculations

Appendix E
VOC Emissions Calculations

Fuel Gas Fired Heaters:

Basis:
Heaters:

5.5	lb-VOC / MMscf (AP-42, 5th Edition, Table 1.4-2)
0.0054	lb-VOC / MM Btu, 1020 Btu/scf (AP-42, 5th Edition, Table 1.4-2)

Flares

0.063	lb-CO / MM Btu (AP-42 Table 13.5-1 and 13.5-2)

Then: VOC emissions = (___ MMBtu/hr) x (___ lb-VOC / MM Btu)

Operating Unit	Emission Source	Firing Rate (MMBtu/hr)	VOC (Estimated) lb/hr	VOC (Estimated) TPY
Coker	Coker Heater	145.0	0.8	3.4
BSI	BSI Heater	50.0	0.3	1.2
#2 H2 Plant	#2 H2 Plant Heater	288.0	1.6	6.8
581 Crude Unit	581 Crude Heater	233	1.3	5.5
583 Vacuum Unit	583 Vacuum Heater	64.2	0.3	1.5
Hydrocracker	Heater H1/H2	38	0.2	0.9
	Heater H3	56	0.3	1.3
	Heater H4	57	0.3	1.3
Hydrocracker	Heater H5	44.9	0.2	1.1
780 FCCU	780 FCC Heater B3	10	<0.1	0.2
	780 FCC Heater H2	19.4	0.1	0.5
#1 HDS	#1HDS Heater	33.4	0.2	0.8
781 Reformer	Naphtha Splitter Heater	46.3	0.2	1.1
	LEF Heater	24.0	0.1	0.6
	#1 Reformer Heater	44.6	0.2	1.1
	#2 Reformer Heater	74.8	0.4	1.8
	#3 Reformer Heater	22.4	0.1	0.5
	Stabilizer Heater	11.1	<0.1	0.3
#4 HDS	H2 Heater (25-HT-101)	22.0	0.1	0.5
	H2 Heater (25-HT-102)	24.0	0.1	0.6
Coker	Coker Unit flare	100.0	6.3	27.6
#1 H2 Plant	#1 H2 Plant Heater	288.0	1.6	6.8
Asphalt Loading	Asphalt Heater #1	8.0	<0.1	0.2
#2 HDS	Charge Heater	28.0	0.2	0.7
#3 HDS	Charge Heater	18.0	<0.1	0.4
Total			15.2	66.6

SRP
Combined Emissions from #1, #2 and #3 TGTU

30.0	MM Btu/hr
5.5	lb-VOC / MMscf (AP-42, 5th Edition, Table 1.4-2)
0.0054	lb-VOC / MM Btu, 1020 Btu/scf (AP-42, 5th Edition, Table 1.4-2)

Then: VOC emissions = (___ MMBtu/hr) x (0.0054 lb-VOC / MM Btu)

Operating Unit	Emission Source	VOC (Estimated) lb/hr	VOC (Estimated) TPY
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	0.16	0.71

FCCU

Basis: 5.3 lb/hr (Average of 2008 and 2009)
23.3 tpy (Average of 2008 and 2009)

Operating Unit	Emission Source	CO (Estimated)	
		lb/hr	TPY
780 FCCU	780 FCCU Regenerator	5.3	23.3

LOLR
Contemporaneous VOC Increase from Light Oil Loading Rack / Flare

Basis:

Facility Throughput:	M gpy
Gasoline	50000
Distillate Fuel Oil	250000
Total	300000

Assume:
Total Organic Compounds (TOC) = Volatile Organic compounds (VOC)

Gasoline Loading (controlled)

Emission Factor 10.0 mg TOC/l Source: 40 CFR 63.422
Emission Factor 0.0834 lb TOC/M gal Source: 40 CFR 63.422

Calculation: TOC Emissions = (___ gal. gasoline /hr)/(____ lb TOC/M gal.) = 0.5 lb TOC/hr

Distillate Fuel Oil Loading (controlled)
Basis:
Loading Losses (lb/1000 gal) = (12.46)(S)(P)(M)/T) Source: AP-42, 5th ed., Section 5.2, equation 1

Where: S = saturation factor 1
P = True Vapor Pressure 0.0042 psia
M = Molecular Weight of Vapor 130
T = Liquid Temperature 507.3 deg. R
E = Control Efficiency 98.0 %

Calculation: VOC Emissions = E*(___ gal. distillate fuel oil / hr)(12.46)(S)(P)(M)/T) = 0.008 lb VOC/hr

Combined Emissions (Gasoline + Distillate Fuel Oil Loading) = 0.5 lb / hr

Operating Unit	Emission Source	VOC (Estimated)	
		lb/hr	TPY
Light Oil Loading	Loading Rack Flare	0.5	2.12

Storage Tanks

Re: Tanks 4.0

Operating Unit	Emission Source	VOC (Estimated)	
		lb/hr	TPY
New Sources			
Tank Farm	100 M bbl tank	34.2	7.8

Re: Tanks 4.0

Operating Unit	Emission Source	VOC (Estimated)	
		lb/hr	TPY
Incremental Increase in Existing Storage Tanks			
	Existing Storage Tanks	2.9	0.7

New Emergency Air Compressor
Hours of operation: 500 hrs/year
20.8 days/year

VOC

Calculation: VOC Emissions = (___ BHP)x(____ g/BHP)

Operating Unit	Emission Source	Engine Power (BHP)	Emission Factor (g/BHP-hr) (Note: 2)	VOC (Estimated)	
				lb/hr	TPY
Boilerhouse	New Emergency Air Compressor	400	1.00	0.88	0.22

Note: 2 Assume HC emission factor from 40 CFR Part 89.112 for Tier I engines

SBG/sbg

Appendix F - Fugitive Emission Calculations

Appendix F
Fugitive Emissions Calculations

Re: Protocol for Equipment Leak Emission Estimates
(EPA-453/R-95-017, Table 2-10: Screening Value Correlations)
Valves / others = 500 ppm, Pumps = 2000 ppm
(EPA-453/R-95-017, Table 2-2: Refinery Average Emission Factors) - Connectors
AP-42, 4 ed, (Fugitive Emission Factors, Table 9.1-2) - Drains

Fuel Gas Service (Note 1)	Pump Seals	Valves	Flanges / Connectors	Drains	Others	VOC Emission Rate (TPY)
Quantity (Note 2)	6	525	1313	40	80	
Emissions Factor (lb/hr-source)	0.0114	0.00052	0.00055	0.0175	0.0001	
Emissions (TPY)	0.3	1.2	3.2	3.1	0.0	7.8

Notes:
Fugitive emission component counts are estimated
Drains are assumed to be included in "Others" category

Fugitive emissions - gasoline service

Component	Liquid Mass Fraction	VOC Emission Rate (TPY)	HAP Emission Rate (TPY)
Benzene	0.0180	0.1399	0.1399
Hexane	0.0100	0.0777	0.0777
Xylene-o	0.0000	0.0000	0.0000
Xylene-m	0.0700	0.5442	0.5442
Xylene-p	0.0000	0.0000	0.0000
Toluene	0.0700	0.5442	0.5442
Ethylbenzene	0.0140	0.1088	0.1088
Trimethylpentane (2,2,4)	0.0400	0.3110	0.3110
Cumene	0.0050	0.0389	0.0389
TOTAL	0.2270	1.76	1.76

SBG/sbg

Appendix G - HAP Emission Calculations

Appendix G
Estimated HAP Emission Calculations - New and Modified Sources

Operating Unit	Emissions Source	Firing Rate (MMBtu/hr)	Arsenic TPY	Beryllium TPY	Cadmium TPY	Chromium(6) TPY	Cobalt TPY	Copper TPY	Lead TPY	Manganese TPY	Mercury TPY	Nickel TPY
New Sources - Potential to Emit												
BSI	BSI Heater	50.0	4.4E-05	2.6E-05	2.4E-04	6.1E-05	1.8E-05	1.8E-04	1.1E-04	8.1E-05	5.5E-05	4.6E-04
Boilerhouse	New Emergency Air Compressor	400.0 HP	2.8E-06	2.1E-06	2.1E-06	2.1E-06	N/A	4.2E-06	6.3E-06	4.2E-06	2.1E-06	2.1E-06
Tank Farm	100 M bbl tank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Equipment Leaks	Fugitive Emissions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Modified Sources - Potential to Emit												
581 Crude Unit	581 Crude Heater	239.00	2.0E-04	1.3E-04	1.1E-03	2.9E-04	8.4E-05	8.5E-04	5.0E-04	3.8E-04	2.6E-04	2.1E-03
583 Vacuum Unit	583 Vacuum Heater	64.2	5.6E-05	3.7E-05	3.1E-04	7.9E-05	2.3E-05	2.3E-04	1.4E-04	1.0E-04	7.0E-05	5.9E-04
Coker	Coker Unit flare	100.000	8.8E-05	5.7E-05	4.8E-04	1.2E-04	3.6E-05	3.6E-04	2.1E-04	1.6E-04	1.1E-04	9.2E-04
781 Reformer	Naphtha Splitter Heater	46.300	4.1E-05	2.6E-05	2.2E-04	5.7E-05	1.7E-05	1.7E-04	9.9E-05	7.5E-05	5.1E-05	4.3E-04
Hydrocracker	Heater H5	44.900	3.9E-05	2.6E-05	2.2E-04	5.5E-05	1.6E-05	1.6E-04	9.5E-05	7.3E-05	4.9E-05	4.1E-04
#1 HDS	#1 HDS Heater	33.400	2.9E-05	1.9E-05	1.6E-04	4.1E-05	1.2E-05	1.2E-04	7.2E-05	5.4E-05	3.7E-05	3.1E-04
SUB-TOTAL			5.0E-04	3.3E-04	2.8E-03	7.0E-04	2.1E-04	2.1E-03	1.2E-03	9.3E-04	6.3E-04	5.3E-03

Operating Unit	Emissions Source	Firing Rate (MMBtu/hr)	Anthracene TPY	Chrysene TPY	Fluoranthene TPY	Fluorene TPY	Naphthalene TPY	Phenanthrene TPY	Benzo(a)pyrene TPY	Acetaldehyde TPY	Phosphorus TPY	Isooctane TPY
New Sources - Potential to Emit												
BSI	BSI Heater	50.0	1.0E-06	3.8E-07	6.4E-07	5.9E-07	1.3E-04	3.7E-06	1.2E-06	2.5E-03	4.8E-04	N/A
Boilerhouse	New Emergency Air Compressor	400.0 HP	1.3E-06	2.5E-07	5.3E-06	2.0E-05	5.9E-05	2.1E-05	1.3E-07	4.2E-06	N/A	N/A
Tank Farm	100 M bbl tank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.7E-02
Equipment Leaks	Fugitive Emissions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.1E-01
Modified Sources - Potential to Emit												
581 Crude Unit	581 Crude Heater	233.0	4.9E-06	1.6E-06	3.0E-06	2.8E-06	6.1E-04	1.7E-05	5.8E-05	1.2E-02	2.2E-03	N/A
583 Vacuum Unit	583 Vacuum Heater	64.2	1.3E-06	4.5E-07	8.2E-07	7.6E-07	1.7E-04	4.8E-06	1.6E-05	3.4E-03	6.2E-04	N/A
Coker	Coker Unit flare	100.0	2.1E-06	7.0E-07	1.3E-06	1.2E-06	2.6E-04	7.4E-05	2.5E-05	5.3E-03	9.6E-04	N/A
781 Reformer	Naphtha Splitter Heater	46.3	9.5E-07	3.2E-07	5.9E-07	5.5E-07	1.2E-04	3.4E-06	1.2E-05	2.4E-03	4.5E-04	N/A
Hydrocracker	Heater H5	44.9	9.2E-07	3.1E-07	5.7E-07	5.3E-07	1.2E-04	3.3E-06	1.1E-05	2.4E-03	4.3E-04	N/A
#1 HDS	#1HDS Heater	33.4	6.9E-07	2.3E-07	4.2E-07	3.9E-07	8.8E-05	2.5E-06	8.3E-06	1.8E-03	3.2E-04	N/A
SUB-TOTAL			1.3E-05	4.3E-06	1.3E-05	2.7E-05	1.6E-03	6.3E-05	1.4E-04	3.0E-02	5.5E-03	3.8E-01

Operating Unit	Emissions Source	Firing Rate (MMBtu/hr)	Benzene TPY	Formaldehyde TPY	Toluene TPY	Ethylbenzene TPY	Hexane TPY	Xylenes TPY	Phenol TPY	Acrolein TPY	Selenium TPY	Cumene TPY	Total HAP TPY
New Sources - Potential to Emit													
BSI	BSI Heater	50.0	4.6E-04	1.6E-02	7.2E-04	3.6E-03	3.9E-01	5.5E-03	8.8E-04	3.7E-03	1.9E-04	N/A	4.3E-01
Boilerhouse	New Emergency Air Compressor	400.0 HP	6.5E-04	8.3E-04	2.9E-04	N/A	N/A	2.0E-04	N/A	6.5E-05	1.1E-05	N/A	2.2E-03
Tank Farm	100 M bbl tank	N/A	8.9E-02	N/A	7.9E-02	6.1E-03	6.3E-02	2.7E-02	N/A	N/A	N/A	1.3E-03	3.1E-01
Equipment Leaks	Fugitive Emissions	N/A	1.4E-01	N/A	5.4E-01	1.1E-01	7.8E-02	5.4E-01	N/A	N/A	N/A	3.9E-03	1.8E+00
Modified Sources - Potential to Emit													
581 Crude Unit	581 Crude Heater	233.0	4.8E-06	1.6E-05	3.0E-05	2.8E-06	6.1E-04	1.7E-05	5.8E-05	1.2E-02	2.2E-03	N/A	3.6E-02
583 Vacuum Unit	583 Vacuum Heater	64.2	5.9E-04	2.1E-02	9.3E-04	4.5E-03	5.1E-01	7.0E-03	1.1E-03	4.8E-03	2.6E-04	N/A	5.5E-01
Coker	Coker Unit flare	100.0	9.2E-04	3.2E-02	1.4E-03	7.0E-03	7.9E-01	1.1E-02	1.8E-03	7.4E-03	3.9E-04	N/A	8.5E-01
781 Reformer	Naphtha Splitter Heater	46.3	4.3E-04	1.5E-02	6.7E-04	3.2E-03	3.7E-01	5.1E-03	8.1E-04	3.4E-03	1.8E-04	N/A	4.0E-01
Hydrocracker	Heater H5	44.9	4.1E-04	1.5E-02	6.5E-04	3.1E-03	3.5E-01	4.9E-03	7.9E-04	3.3E-03	1.7E-04	N/A	3.9E-01
#1 HDS	#1HDS Heater	33.4	6.9E-07	2.3E-07	4.2E-07	3.9E-07	8.8E-05	2.5E-06	8.3E-06	1.8E-03	3.2E-04	N/A	5.2E-03
SUB-TOTAL			2.1E-01	1.0E-01	6.3E-01	1.4E-01	2.5E+00	6.0E-01	5.4E-03	3.7E-02	3.8E-03	4.0E-02	4.7E+00

Notes:

1) Fuel combustion emissions factors are listed in Table G.1
2) Tank emissions calculated from speciation in TANKS 4.09 database
3) Fugitive emissions based on speciation of gasoline

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Table G1

HAP Emission Factors for Heaters

Category	HAP		Emission Factor lb/MMBtu
Metals	Arsenic		2.00E-07
	Beryllium		1.30E-07
	Cadmium		1.10E-06
	Chromium(6)		2.80E-07
	Cobalt		8.20E-08
	Copper		8.30E-07
	Lead		4.90E-07
	Manganese		3.70E-07
	Mercury		2.50E-07
	Nickel		2.10E-06
	Phosphorus		2.20E-06
	Selenium		8.80E-07
PAH	Anthracene		4.70E-09
	Chrysene		1.80E-09
	Fluoranthene		2.80E-09
	Fluorene		2.70E-09
	Naphthalene		6.00E-07
	Phenanthrene		1.70E-08
	Benzo(a)pyrene		5.70E-08

Category	HAP	Emission Factor lb/MMBtu
VOC	Acetaldehyde	1.20E-05
	Benzene	2.10E-06
	Formaldehyde	7.40E-05
	Toluene	3.30E-06
	Ethylbenzene	1.60E-05
	Hexane	1.80E-03
	Xylenes	2.50E-05
	Phenol	4.30E-06
	Acrolein	1.70E-06

HAP Emission Factors for Emergency Air Compressor

Category	HAP		Emission Factor lb/MMBtu
Metals	Arsenic		4.00E-06
	Beryllium		3.00E-06
	Cadmium		3.00E-06
	Chromium		3.00E-06
	Cobalt		--
	Copper		6.00E-06
	Lead		9.00E-06
	Manganese		6.00E-06
	Mercury		3.00E-06
	Nickel		3.00E-06
	Phosphorus		--
	Selenium		1.50E-05
PAH	Anthracene		1.87E-06
	Chrysene		3.53E-07
	Fluoranthene		7.61E-06
	Fluorene		2.92E-05
	Naphthalene		8.48E-05
	Phenanthrene		2.94E-05
	Benzo(a)pyrene		1.88E-07

Category	HAP	Emission Factor lb/MMBtu
VOC	Acetaldehyde	7.67E-04
	Benzene	9.33E-04
	Formaldehyde	1.18E-03
	Toluene	4.09E-04
	Ethylbenzene	--
	Hexane	--
	Xylenes	2.85E-04
	Phenol	--
	Acrolein	9.25E-05

7000 When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr.

Emission Factor Sources:

1 EER Report	Air Toxics Emissions Factors for Petroleum Industry Combustion Devices, November 20, 1997, Energy and Environmental Research Corp.
2 MACT Floor Presentation:	MACT Floor Analysis Presentation" to SWG by Jim Eddinger, January 13-14, 1998 (compilation of data from EPA database by ERG)
3 API Study:	"Air Toxics Emissions Factors for Combustion Sources Using Petroleum-Based Fuels" Vol. 1, Development of Emission Factors Using API/WSPA Approach, October 17, 1997, Table ES-1
4 AP-42	AP 42, Fifth Edition, Volume I Chapter 3: Stationary Internal Combustion Sources Gasoline and Diesel Industrial Engines http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s03.pdf
5 Emission Estimation Protocol for Petroleum Refineries	Emission Estimation Protocol for Petroleum Refineries Version 2.1: Final ICR Version Form Approved: 08/29/2011 OMB Control No.: 2060-0657 https://refineryicr.rti.org/Portals/0/Emission_Estimation_Protocol_for_Petroleum_Refineries.pdf

Appendix H – PSD Netting Emissions

Appendix H
PSD Netting Emissions

EMISSIONS INCREASES

Operating Unit	Emission Source	Current Firing Rate	Firing Rate for Allowable/Estimated Emissions	SO2 Allowable Emissions	NOx Allowable Emissions	PM Allowable Emissions	PM 10 Estimated Emissions	PM 2.5 Estimated Emissions	CO Estimated Emissions	VOC Estimated Emissions
		(MMBtu/hr)	(MMBtu/hr)	TPY	TPY	TPY	TPY	TPY	TPY	TPY
Modified and New Sources:										
581 Crude Unit	581 Crude Heater	133.2	233.0	8.9	30.6	1.9	1.9	1.9	40.8	5.5
583 Vacuum Unit	583 Vacuum Heater	64.2	64.2	2.5	8.4	0.5	0.5	0.5	11.2	1.5
Coker	Coker Unit flare	N/A	100.0	3.8	29.8	0.8	0.8	0.8	162.1	27.6
781 Reformer	Naphtha Splitter Heater	34.5	46.3	1.8	7.1	0.4	0.4	0.4	8.1	1.1
Hydrocracker	Heater H5	35.7	44.9	1.7	6.9	0.4	0.4	0.4	7.9	1.1
#1 HDS	#1HDS Heater	24.0	33.4	1.3	5.1	0.3	0.3	0.3	5.9	0.8
BSI	BSI Heater	N/A	50.0	1.9	6.6	0.4	0.4	0.4	8.8	1.2
Boilerhouse	New Emergency Air Compressor	N/A	N/A	<0.1	0.7	<0.1	<0.1	<0.1	0.6	0.2
Tank Farm	100 M bbl tank	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.8
Equipment Leaks	Fugitive Emissions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.8
Subtotal Modified and New Sources:				21.9	95.2	4.7	4.7	4.7	245.3	54.5

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EMISSIONS INCREASES

Operating Unit	Emission Source	Current Firing Rate	Firing Rate for Allowable/ Estimated Emissions	SO2 Allowable Emissions	NOx Allowable Emissions	PM Allowable Emissions	PM 10 Estimated Emissions	PM 2.5 Estimated Emissions	CO Estimated Emissions	VOC Estimated Emissions
		(MMBtu/hr)	(MMBtu/hr)	TPY	TPY	TPY	TPY	TPY	TPY	TPY
Non-Modified Sources:										
781 Reformer	LEF Heater	24.0	24.0	0.9	3.7	0.2	0.2	0.2	4.2	0.6
	#1 Reformer Heater	44.6	44.6	1.7	6.8	0.4	0.4	0.4	7.8	1.1
	#2 Reformer Heater	74.8	74.8	2.9	11.5	0.6	0.6	0.6	13.1	1.8
	#3 Reformer Heater	22.4	22.4	0.9	3.4	0.2	0.2	0.2	3.9	0.5
	Stabilizer Heater	11.1	11.1	0.4	1.7	<0.1	<0.1	<0.1	1.9	0.3
Hydrocracker	Heater H1/H2	38.0	38.0	1.5	5.8	0.3	0.3	0.3	6.7	0.9
	Heater H3	56.0	56.0	2.1	8.6	0.5	0.5	0.5	9.8	1.3
	Heater H4	57.0	57.0	2.2	8.7	0.5	0.5	0.5	10.0	1.3
Coker	Coker Heater	145.0	145.0	5.5	21.0	1.2	1.2	1.2	25.4	3.4
	Coker (Material Handling)	N/A	N/A	N/A	N/A	Insignificant	Insignificant	Insignificant	N/A	N/A
780 FCCU	780 FCC Heater B3	10.0	10.0	0.4	10.1	<0.1	<0.1	<0.1	3.6	0.2
	780 FCC Heater H2	19.4	19.4	0.7	19.5	0.2	0.2	0.2	7.0	0.5
	780 FCCU Regenerator	N/A	N/A	57.8	66.6	70.5	70.5	48.7	504.0	23.3
#2 HDS	Charge Heater	28.0	28.0	1.1	4.3	0.2	0.2	0.2	4.9	0.7
#3 HDS	Charge Heater	18.0	18.0	0.7	2.8	0.1	0.1	0.1	3.2	0.4
#4 HDS	H2 Heater (25-HT-101)	22.0	22.0	0.8	3.4	0.2	0.2	0.2	3.9	0.5
	H2 Heater (25-HT-102)	24.0	24.0	0.9	3.7	0.2	0.2	0.2	4.2	0.6
#1 H2 Plant	#1 H2 Plant Heater	288.0	288.0	0.5	82.0	2.3	2.3	2.3	103.9	6.8
#2 H2 Plant	#2 H2 Plant Heater	N/A	288.0	5.6	12.6	2.3	2.3	2.3	25.2	6.8
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	N/A	N/A	84.6	9.2	0.2	0.2	0.2	39.4	0.7
Asphalt Loading	Asphalt Heater #1	8.0	8.0	0.3	8.1	<0.1	<0.1	<0.1	2.9	0.2
Tank Farm	Working Losses	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.7
Light Oil Loading	Loading Rack Flare	N/A	N/A	N/A	0.8	N/A	N/A	N/A	2.1	2.1
Subtotal Non-Modified Sources:				171.4	294.3	80.3	80.3	58.6	787.1	54.7
TOTAL: MODIFIED + NEW + NON MODIFIED SOURCES				193.3	389.4	85.0	85.0	63.3	1,032.4	109.2

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PAST ACTUAL EMISSIONS

Operating Unit	Emission Source	SO2 Actual Emissions TPY	NOx Actual Emissions TPY	PM Actual Emissions TPY	PM 10 Estimated Emissions TPY	PM 2.5 Estimated Emissions TPY	CO Actual Emissions TPY	VOC Actual Emissions TPY
581 Crude Unit	581 Crude Heater	1.7	9.9	0.7	0.7	0.7	0.4	2.1
583 Vacuum Unit	583 Vacuum Heater	0.4	3.5	0.2	0.2	0.2	1.0	0.5
781 Reformer	Naphtha Splitter Heater	0.1	0.7	<0.1	<0.1	<0.1	1.5	0.2
	LEF Heater	0.3	1.0	0.1	0.1	0.1	2.5	0.3
	#1 Reformer Heater	0.5	1.9	0.2	0.2	0.2	9.5	0.6
	#2 Reformer Heater	0.4	2.2	0.2	0.2	0.2	7.2	0.5
	#3 Reformer Heater	0.2	1.0	<0.1	<0.1	<0.1	2.9	0.2
	Stabilizer Heater	0.2	0.7	<0.1	<0.1	<0.1	1.5	0.2
Hydrocracker	Heater H1/H2	0.2	3.2	0.1	0.1	0.1	5.1	0.3
	Heater H3	0.3	5.2	0.2	0.2	0.2	7.8	0.5
	Heater H4	0.5	8.8	0.3	0.3	0.3	13.6	0.9
	Heater H5	0.2	3.4	0.1	0.1	0.1	2.5	0.4
Coker	Coker Heater	1.0	6.5	0.4	0.4	0.4	6.5	1.3
	Coker (Material Handling)	N/A	N/A	Trivial	Trivial	Trivial	N/A	N/A
780 FCCU	780 FCC Heater B3	<0.1	2.2	<0.1	<0.1	<0.1	1.9	0.1
	780 FCC Heater H2	0.2	4.2	<0.1	<0.1	<0.1	3.5	0.2
	780 FCCU Regenerator	57.8	66.6	70.5	70.5	48.7	504.0	23.3
#1 HDS	#1HDS Heater	0.2	0.9	<0.1	<0.1	<0.1	2.0	0.3
#2 HDS	Charge Heater	<0.1	0.3	<0.1	<0.1	<0.1	0.8	<0.1
#3 HDS	Charge Heater	0.2	1.1	<0.1	<0.1	<0.1	3.0	0.2
#4 HDS	H2 Heater (25-HT-101)	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	0.1
	H2 Heater (25-HT-102)	<0.1	0.5	<0.1	<0.1	<0.1	1.6	0.1
#1 H2 Plant	#1 H2 Plant Heater	0.3	36.9	1.4	1.4	1.4	60.9	4.0
#2 H2 Plant	#2 H2 Plant Heater	5.6	12.6	2.3	2.3	2.3	25.2	6.8
#1,#2,#3,#4 SRU	#1,#3,#4 TGTU	40.2	4.2	0.2	0.2	0.2	2.2	0.5
Asphalt Loading	Asphalt Heater #1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tank Farm	Working Losses	N/A	N/A	N/A	N/A	N/A	N/A	NA
Light Oil Loading	Loading Rack Flare	N/A	N/A	N/A	N/A	N/A	N/A	0.5
TOTAL: PAST ACTUAL EMISSIONS		110.8	177.9	77.5	77.5	55.8	667.2	44.3

CONTEMPORANEOUS CHANGES

	Emission Source	SO2 Actual Emissions	NOx Actual Emissions	CO Actual Emissions	VOC Actual Emissions
		TPY	TPY	TPY	TPY
Increases	New CatOx (AP-11891)	<0.1	0.5	0.4	0.4
	Tank 406 (Change from EFR TO IRF)	N/A	N/A	N/A	<0.1
	Tank 498 (WV-11941)	N/A	N/A	N/A	1.1
	Evaporation Pond Water Transfer Pump (WV-11200)	<0.1	2.4	2.6	2.4
	Renewable Fuels Project (AP-11189)	Insignificant	2.8	7.1	8.7
	Pipeline Relief Storage Tanks (WV-10487)	N/A	N/A	N/A	1.8
	Boilerhouse Emergency Generator (MD-10656)	<0.1	0.2	7.2	0.2
	Steam Reliability and Fuel Gas Balance Project (MD-9659)	15.7	24.2	32.4	13.9
	Alky Turnaround Project (MD-10256)	N/A	N	N/A	2.2
	Delayed Coker Unit Project (MD-1381 A2)	956.6	362.8	540.9	105.3
	Boilerhouse Upgrade Project (MD-7911)	13.9	32.4	63.7	9.0
	Total	986.3	425.4	654.3	145.0
Decreases	BHFO CD reductions (MD-9659)	16.4	N/A	N/A	N/A
	Steam Reliability and Fuel Gas Balance Project (MD-9659)	N/A	N/A	25.2	6.8
	Delayed Coker Unit Project (MD-1381 A2)	916.7	353.5	479.8	48.6
	BHFO CD reductions (MD-9659)	31.0	N/A	N/A	N/A
	Shut down #10 HPB (MD-7911)	0.4	55.7	31.6	2.1
	Tank 509	N/A	N/A	N/A	0.9
	Controlled Drains (MD-9659)	N/A	N/A	N/A	8.0
	Old Firewater Pump	<0.1	0.5	<0.1	<0.1
	API Separator remove from service (MD-1381A2)	N/A	N/A	N/A	14.1
	Total	964.6	409.7	536.7	80.5
NET Contemporaneous Changes		21.8	15.7	117.6	64.5

SUMMARY

		SO2 Emissions	NOx Emissions	CO Emissions	VOC Emissions
		TPY	TPY	TPY	TPY
NET EMISSIONS INCREASE with Contemporaneous Changes		104.2	227.2	482.8	129.5
PSD SIGNIFICANCE THRESHOLDS		40.0	40.0	100.0	40.0

SBG/sbg

Appendix I – New and Modified Heater - SCR Cost Analysis

Appendix Ia
BACT Analysis for SCR on 581 Crude Unit Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	233	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.87	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	41559	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	115807	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	0.992	none	NOx efficiency adjustment factor
2.21	NOx adj	0.862	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	2.322	none	Temperature adjustment factor
2.19	Vol catalyst	1466.0	ft3	Catalyst volume
2.25	Catalyst area	120.6	ft2	Cross sectional area of reactor
2.26	Geometry adj.	138.7	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	11.8	ft	Reactor length and width
2.28	n layer	3.4	ft	Number of catalyst layers
	rounding	3.0	ft	Rounded catalyst layers
2.29	h layer	4.5	ft	Catalyst layer height
	rounding	5.0	ft	Rounded catalyst layer height
2.30	n total	4.0	none	Total number of catalyst layers
2.31	h SCR	57.0	ft	Reactor height
2.32	m reagent	1.8	lb/hr	reagent consumption
2.33	m sol	6.2	lb/hr	aqueous reagent consumption
2.34	q sol	0.8	gph	aqueous reagent consumption
2.35	tank volume	280.3	gal	on-site storage volume
2.37	f(h SCR)	160.94	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-44.11	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	0.00	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	0.55	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$498,444	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$2,721,970	$	direct capital cost - 1998 Manual
	annual inflation	7.0	%	Annual Inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$4,983,538	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$249,177	$	5% of DCC
Engineering and Home Office	$498,354	$	10% of DCC
Process Contingency	$249,177	$	5% of DCC
ICC	$996,708		

Project Contingency

Project Contingency	$897,037	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$6,877,282	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$137,546	$	2% of Total Plant Cost
Inventory capital	$212	$	Ammonia soln. Inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$137,758	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$7,015,040	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$105,226	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$5,526	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	86	kW	power consumption
2.49	Electricity	$37,719	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$166,148	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$50,196	$	Annual Replacement Cost
2.45	DAC	$213,668	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$1,141,665	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$1,355,331	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	20.4	tons	Tons NOx removed
2.58	Cost Effectiveness	$66,403	$/ton	Cost Effectiveness

Appendix Ib
BACT Analysis for SCR on 583 Vacuum Unit Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	64.2	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.67	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	11451	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	40881	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	0.992	none	NOx efficiency adjustment factor
2.21	NOx adj	0.862	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj.	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	1.091	none	Temperature adjustment factor
2.19	Vol catalyst	189.9	ft3	Catalyst volume
2.25	Catalyst area	42.6	ft2	Cross sectional area of reactor
2.26	Geometry adj.	49.0	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	7.0	ft	Reactor length and width
2.28	n layer	1.3	ft	Number of catalyst layers
	rounding	1.0	ft	Rounded catalyst layers
2.29	h layer	4.9	ft	Catalyst layer height
	rounding	5.0	ft	Rounded catalyst layer height
2.30	n total	2.0	none	Total number of catalyst layers
2.31	h SCR	33.0	ft	Reactor height
2.32	m reagent	0.5	lb/hr	reagent consumption
2.33	m sol	1.7	lb/hr	aqueous reagent consumption
2.34	q sol	0.2	gph	aqueous reagent consumption
2.35	tank volume	77.2	gal	on-site storage volume
2.37	f(h SCR)	14.06	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-44.11	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	0.00	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	1.98	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$64,555	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$1,056,757	$	direct capital cost - 1998 Manual
	annual inflation	7.9	%	Annual inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$1,934,770	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$96,739	$	5% of DCC
Engineering and Home Office	$193,477	$	10% of DCC
Process Contingency	$96,739	$	5% of DCC
ICC	$386,954		

Project Contingency

Project Contingency	$348,259	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$2,669,983	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$53,400	$	2% of Total Plant Cost
Inventory capital	$58	$	Ammonia soln. inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$53,458	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$2,723,441	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$40,852	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$1,522	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	17	kW	power consumption
2.49	Electricity	$7,440	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$64,555	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$19,503	$	Annual Replacement Cost
2.45	DAC	$84,318	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$443,227	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$527,545	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	5.6	tons	Tons NOx removed
2.58	Cost Effectiveness	$93,804	$/ton	Cost Effectiveness

Appendix Ic
BACT Analysis for SCR on #1 HDS Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	33.4	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.71	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	5957	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	31641	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	1.043	none	NOx efficiency adjustment factor
2.21	NOx adj	0.864	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj.	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	12.659	none	Temperature adjustment factor
2.19	Vol catalyst	1206.3	ft3	Catalyst volume
2.25	Catalyst area	33.0	ft2	Cross sectional area of reactor
2.26	Geometry adj.	37.9	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	6.2	ft	Reactor length and width
2.28	n layer	10.3	ft	Number of catalyst layers
	rounding	10.0	ft	Rounded catalyst layers
2.29	h layer	4.2	ft	Catalyst layer height
	rounding	4.0	ft	Rounded catalyst layer height
2.30	n total	11.0	none	Total number of catalyst layers
2.31	h SCR	130.0	ft	Reactor height
2.32	m reagent	0.3	lb/hr	reagent consumption
2.33	m sol	1.1	lb/hr	aqueous reagent consumption
2.34	q sol	0.1	gph	aqueous reagent consumption
2.35	tank volume	50.2	gal	on-site storage volume
2.37	f(h SCR)	607.7	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-43.31	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	0.00	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	3.80	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$410,129	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$1,201,956	$	direct capital cost - 1998 Manual
	annual inflation	7.9	%	Annual inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$2,200,609	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$110,030	$	5% of DCC
Engineering and Home Office	$220,061	$	10% of DCC
Process Contingency	$110,030	$	5% of DCC
ICC	$440,122		

Project Contingency

Project Contingency	$396,110	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$3,036,841	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$60,737	$	2% of Total Plant Cost
Inventory capital	$38	$	Ammonia soln. inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$60,775	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$3,097,616	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$46,464	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$990	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	25	kW	power consumption
2.49	Electricity	$10,791	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$41,013	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$12,391	$	Annual Replacement Cost
2.45	DAC	$85,636	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$504,123	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$589,758	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	3.7	tons	Tons NOx removed
2.58	Cost Effectiveness	**$161,255**	$/ton	Cost Effectiveness

Appendix Id
BACT Analysis for SCR on Naphtha Splitter Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	46.3	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.71	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	8258	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	20616	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	1.043	none	NOx efficiency adjustment factor
2.21	NOx adj	0.864	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj.	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	3.791	none	Temperature adjustment factor
2.19	Vol catalyst	500.8	ft3	Catalyst volume
2.25	Catalyst area	21.5	ft2	Cross sectional area of reactor
2.26	Geometry adj.	24.7	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	5.0	ft	Reactor length and width
2.28	n layer	6.5	ft	Number of catalyst layers
	rounding	7.0	ft	Rounded catalyst layers
2.29	h layer	3.9	ft	Catalyst layer height
	rounding	4.0	ft	Rounded catalyst layer height
2.30	n total	8.0	none	Total number of catalyst layers
2.31	h SCR	97.0	ft	Reactor height
2.32	m reagent	0.4	lb/hr	reagent consumption
2.33	m sol	1.6	lb/hr	aqueous reagent consumption
2.34	q sol	0.2	gph	aqueous reagent consumption
2.35	tank volume	69.6	gal	on-site storage volume
2.37	f(h SCR)	405.74	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-43.31	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	0.00	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	2.74	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$170,273	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$1,078,260	$	direct capital cost - 1998 Manual
	annual inflation	7.9	%	Annual inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$1,974,156	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$98,708	$	5% of DCC
Engineering and Home Office	$197,416	$	10% of DCC
Process Contingency	$98,708	$	5% of DCC
ICC	$394,831		

Project Contingency

Project Contingency	$355,348	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$2,724,335	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$54,487	$	2% of Total Plant Cost
Inventory capital	$53	$	Ammonia soln. inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$54,539	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$2,778,874	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$41,683	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$1,372	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	27	kW	power consumption
2.49	Electricity	$11,765	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$24,325	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$7,349	$	Annual Replacement Cost
2.45	DAC	$77,169	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$452,249	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$529,418	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	5.1	tons	Tons NOx removed
2.58	Cost Effectiveness	**$104,425**	$/ton	Cost Effectiveness

Appendix Ie
BACT Analysis for SCR on Hydrocracker H5 Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	44.9	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.71	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	8009	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	24873	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	1.043	none	NOx efficiency adjustment factor
2.21	NOx adj	0.864	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj.	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	1.338	none	Temperature adjustment factor
2.19	Vol catalyst	171.4	ft3	Catalyst volume
2.25	Catalyst area	25.9	ft2	Cross sectional area of reactor
2.26	Geometry adj.	29.8	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	5.5	ft	Reactor length and width
2.28	n layer	1.9	ft	Number of catalyst layers
	rounding	2.0	ft	Rounded catalyst layers
2.29	h layer	3.9	ft	Catalyst layer height
	rounding	4.0	ft	Rounded catalyst layer height
2.30	n total	3.0	none	Total number of catalyst layers
2.31	h SCR	42.0	ft	Reactor height
2.32	m reagent	0.4	lb/hr	reagent consumption
2.33	m sol	1.5	lb/hr	aqueous reagent consumption
2.34	q sol	0.2	gph	aqueous reagent consumption
2.35	tank volume	67.5	gal	on-site storage volume
2.37	f(h SCR)	69.14	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-43.31	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	0.00	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	2.83	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$58,282	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$881,303	$	direct capital cost - 1998 Manual
	annual inflation	7.9	%	Annual inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$1,613,539	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$80,677	$	5% of DCC
Engineering and Home Office	$161,354	$	10% of DCC
Process Contingency	$80,677	$	5% of DCC
ICC	$322,708		

Project Contingency

Project Contingency	$290,437	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$2,226,684	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$44,534	$	2% of Total Plant Cost
Inventory capital	$51	$	Ammonia soln. inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$44,585	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$2,271,269	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$34,069	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$1,331	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	14	kW	power consumption
2.49	Electricity	$6,246	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$29,141	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$8,804	$	Annual Replacement Cost
2.45	DAC	$65,450	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$369,639	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$435,089	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	4.9	tons	Tons NOx removed
2.58	Cost Effectiveness	$88,495	$/ton	Cost Effectiveness

Appendix If
BACT Analysis for SCR on BSI Heater

SCR BACT analysis (ULNB baseline)
Basis:
EPA Air Pollution Control Cost Manual - Sixth Edition (EPA 452/B-02-001)

Direct Capital Cost (DCC)

Equation	Parameter	Value	Units	Description
2.3	Qb	50	MM Btu/hr	Heat Release (HHV)
2.9	N NOx	0.67	none (fraction)	NOx removal Efficiency
2.11	ASR	1.05	none	Actual stoichiometric ratio (default)
	q fuel gas	8918	scfm (wet)	Gas flow rate (from method 19 "F factor")
2.12	q fuel gas	27698	acfm (wet)	Gas flow rate
2.17	Ammonia Slip	2	ppm	Ammonia slip adjustment factor
2.20	N adj	0.992	none	NOx efficiency adjustment factor
2.21	NOx adj	0.862	none	Inlet NOx adjustment factor
2.22	Slip adj	1.170	none	Ammonia slip adjustment factor
2.23	Sulfur adj.	0.964	none	Fuel sulfur adjustment factor
2.24	Temp adj.	1.338	none	Temperature adjustment factor
2.19	Vol catalyst	181.3	ft3	Catalyst volume
2.25	Catalyst area	28.9	ft2	Cross sectional area of reactor
2.26	Geometry adj.	33.2	ft2	Cross sectional area with adjustment
2.27	Reactor l & w	5.8	ft	Reactor length and width
2.28	n layer	1.8	ft	Number of catalyst layers
	rounding	2.0	ft	Rounded catalyst layers
2.29	h layer	3.7	ft	Catalyst layer height
	rounding	4.0	ft	Rounded catalyst layer height
2.30	n total	3.0	none	Total number of catalyst layers
2.31	h SCR	42.0	ft	Reactor height
2.32	m reagent	0.4	lb/hr	reagent consumption
2.33	m sol	1.3	lb/hr	aqueous reagent consumption
2.34	q sol	0.2	gph	aqueous reagent consumption
2.35	tank volume	60.2	gal	on-site storage volume
2.37	f(h SCR)	69.14	$/MM Btu	reactor height adjustment factor
2.38	f(NH3 rate)	-44.11	$/MM Btu	ammonia flowrate adjustment factor
2.39 & 2.4	f(new)	-14.56	$/MM Btu	New Furnace, Zero for Retrofit
2.42	f(bypass)	2.54	$/MM Btu	with SCR bypass
2.43	f(Vol catalyst)	$61,652	$	cost of initial catalyst @ $340/ft3
	CEMS	$120,000	$	NH3/NOx monitor (Note: added for this analysis, not included in EPA 452/B-02-001
2.36	DCC	$932,133	$	direct capital cost - 1998 Manual
	annual inflation	7.0	%	Annual inflation rate 2008 to 2011 Nelson Farrar Refinery Inflation Index
	DCC	$1,706,602	$	direct capital cost - 2011

Indirect Capital Cost (ICC)

General Facilities	$85,330	$	5% of DCC
Engineering and Home Office	$170,660	$	10% of DCC
Process Contingency	$85,330	$	5% of DCC
ICC	$341,320		

Project Contingency

Project Contingency	$307,188	$	15% of DCC + ICC

Total Plant Cost

Total Plant Cost	$2,355,111	$	DCC+ICC+Project Contingency

Allowances

Allowance for funds during construction	$0	$	Assume 0 for SCR
Royalty allowance	$0	$	Assume 0 for SCR
Preproduction cost	$47,102	$	2% of Total Plant Cost
Inventory capital	$45	$	Ammonia soln. inventory @ $0.101/lb
Initial Catalyst and Chemicals	$0	$	Assume 0 for SCR
Subtotal allowances	$47,148	$	

Total Capital Investment (TCI)

Total Capital Investment (TCI)	$2,402,259	$	

Direct Annual Costs

Equation	Parameter	Value	Units	Description
2.46	Maintenance	$36,034	$	Annual maintenance cost = 1.5% TCI
2.47	Reagent	$1,166	$	Ammonia soln. usage @ $0.101/lb
2.48	Power	16	kW	power consumption
2.49	Electricity	$6,944	$	$0.05/kWh
	Performance Testing	$15,000	$	per year (initial and annual RATA)
Catalyst Replacement				
2.50	CRC	$30,826	$	Catalyst Replacement Cost @ $340/ft3, replacing 1 layer per year
	hcatalyst	24000	hours	catalyst life (assume 24,000 hrs)
	hyear	8760	hours	hours per year
2.53	Y	2.74	none	Y factor for eq. 2.52
	rounding	3.0	none	
	interest	0.1	none	annual interest rate (fraction)
2.52	FWF	0.302	none	Future Worth Factor
2.51	ARC	$9,313	$	Annual Replacement Cost
2.45	DAC	$68,477	$	Direct Annual Costs = maint.+reagent+electricity+catalyst

Indirect Costs

	period	10	years	assume 10 year equipment life
	interest	0.1	none	annual interest rate (fraction)
2.55	CRF	0.163	none	Capital Recovery Factor
2.54	IDAC	$390,957	$	Indirect Annual Cost

Total Annual Cost

2.56	TAC	$459,434	$	Total Annual Cost

Cost Effectiveness

2.57	NOx removed	4.4	tons	Tons NOx removed
2.58	Cost Effectiveness	$104,694	$/ton	Cost Effectiveness

Appendix J – Detailed Ambient Air Quality Modeling Analysis

Sinclair Wyoming Refining Company

Crude Optimization Project
Air Dispersion Modeling Report

October 10, 2011

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SECTION 1
GENERAL MODELING DISCUSSION

Sinclair Wyoming Refining Company (SWRC) owns and operates a refinery located in Sinclair, Carbon County, Wyoming. The site is currently a major source for Prevention of Significant Deterioration (PSD) since the site wide Potential to Emit (PTE) for all criteria pollutants is greater than 250 tpy. The proposed facility modifications trigger PSD review for numerous criteria pollutants as described in Section 1.2 and in the permit application document submitted to WDEQ-AQD.

1.1 Project Overview

SWRC is planning to increase the crude oil refining capacity and implement other miscellaneous projects at its petroleum refinery located in Sinclair, Wyoming. The crude optimization project consists of:

- Removal of the 581 Crude Unit heater firing rate limit and replacement of the 581 Crude Unit atmospheric distillation tower;
- Modification of the 583 Vacuum tower to accommodate the resulting increase in reduced crude feedstock from the debottlenecked 581 Crude Unit; and
- Allowing the combustion of sweetened refinery fuel gas in the Coker Flare to accommodate potential periods when the refinery may have to operate in a fuel gas imbalance condition.

In addition, the application includes the following projects that are unrelated to the increase of crude oil refining capacity:

- Removal of the firing rate limits for the #1 HDS heater, Naphtha Splitter heater and Hydrocracker H5 heater so that these units will able to fire at their design maximum firing rates. This change will eliminate the requirement for fuel gas flow monitor testing to demonstrate that these heaters operate at the sub-design firing rates specified in the current permit. Note that this action is being requested solely to eliminate the need for annual fuel gas flow meter testing.
- Installation of a new Naphtha Splitter and Benzene Saturation/Isomerization (BSI) Unit to provide the capability to reduce the benzene content in the refinery's gasoline product to meet the specifications of the February 2007 Mobile Source Air Toxics II (MSAT II) rule. This potential project is totally unrelated to the Crude Oil Optimization Project. Depending on SWRC's success at meeting MSAT II requirements using the current refinery configuration, SWRC may elect to forego installing a new Naphtha Splitter and/or BSI unit.

- Upgrade of the refinery's sour water stripping system which will include increasing the capacity of the existing sour water stripping system and installation of an additional sour water stripper. Sour water is a byproduct of the refining process that refers to water containing hydrogen sulfide and ammonia. A sour water stripper removes the H_2S and Ammonia gases from sour water using steam heat. The gases then go to the refinery Sulfur Recovery Plants where 99+% of the sulfur is recovered as product sulfur. The stripped water is either used in other refining processes or goes to the refinery wastewater treatment plant for processing. The installation of the new sour water stripper will improve the refinery's ability for continuous sour water stripping and is included in the project description for completeness.

- Installation of a new emergency air compressor that will supply instrument air to the refinery in the event of a power failure.

A more detailed process description of the proposed project can be found in the permit application document.

1.2 Modeling Applicability and Pollutants to be Evaluated

SWRC is located in Carbon County and is designated as attainment or unclassifiable for all criteria pollutants and is a Class II PSD area as defined by U.S. EPA.[1] The proposed project was evaluated to determine whether it triggers certain applicable requirements of the Clean Air Act (CAA), including the PSD requirements of 40 CFR Part 52.21. A PSD permitting applicability review was conducted for the proposed emission rate increases of CO, SO_2, NO_x, VOC, PM_{10}, and $PM_{2.5}$. The emission calculations provided in the air permit application demonstrate that the proposed project is subject to PSD permitting requirements for all but PM_{10} and $PM_{2.5}$. These pollutants are still subject to state-level WAAQS review.

Additional state-level modeling was required for inhalation risk assessments for several HAPs. These analyses are discussed in Section 11.7.

SWRC contracted with Sage Environmental Consulting, L.P. (Sage) to prepare the pre-modeling protocol, conduct modeling, and to prepare the PSD modeling report for the project. The PSD modeling was conducted to evaluate potential impacts of the applicable criteria pollutant emissions associated with the proposed project to the ambient air. The PSD modeling was conducted according to the requirements of the U.S. EPA and WDEQ-AQD modeling guidelines and manuals[2,3,4].

A pre-modeling protocol was submitted to WDEQ-AQD on September 19, 2011. WDEQ-AQD provided comments to the pre-modeling protocol via electronic mail dated September 20, 2011 from Mr. Josh Nall -- NSR Program Principal, Dispersion Modeling. The items discussed in the

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[1] 40 CFR §52.21(c)(3)

[2] U.S. EPA, *Guideline on Air Quality Models (Revised). Appendix W of 40 CFR, Part 51.* EPA-450/2-78-027R, November 2005.

[3] U.S. EPA, *Draft New Source Review Workshop Manual. Prevention of Significant Deterioration and Nonattainment Area Permitting.* U.S. EPA, Office of Air Quality, October 1990.

[4] WDEQ, *WDEQ-AQD Major Source/PSD Modeling Guidance, January, 2010.*

e-mail were agreed to be valid by SWRC and Sage and has incorporated Mr. Nall's comments into this modeling analysis.

1.2.1 General PSD Modeling Approach

The guidance for performing PSD air quality analyses is set forth in Chapter C of U.S. EPA's New Source Review Workshop Manual, Draft - October 1990, and in U.S. EPA's "Guideline on Air Quality Models", 40 CFR Part 51 Appendix W (referred to as the GAQM). These PSD modeling guidance documents address modeling for 1-hour and 8-hour CO; annual NO_2; and 24-hour and annual PM_{10} averaging periods.

Numerous changes in EPA requirements for PSD air quality analyses were promulgated in 2010 and 2011. These changes include:

- Updated $PM_{2.5}$ modeling guidance[5,6] issued on February 26 and March 23, 2010;
- Finalized Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC) for $PM_{2.5}$ which became effective on December 20, 2010;
- Finalized PSD Increments for $PM_{2.5}$ which become effective on October 20, 2011;
- A new 1-hour NO_2 National Ambient Quality Standard (NAAQS)[7] which became effective on April 12, 2010;
- 1-hour NO_2 modeling guidelines[8,9] released on June 29, 2010 and March 1, 2011;
- A new 1-hour SO_2 National Ambient Quality Standard (NAAQS) which became effective in June 2010;
- 1-hour SO_2 modeling guidelines released in August, 2010; and
- AERMOD User's Guide Addendum, March 2011.

In summary, SWRC is required to address compliance with the standards listed in the following Table 1-1.

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[5] U.S. EPA, *Review of Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS.* EPA's SCRAM Web page
[6] U.S. EPA, *Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS.* Memorandum, March 23, 2010.
[7] U.S. EPA, *Primary National Ambient Air Quality Standards for NO_2.* Federal Register V. 75 N. 26, February 9, 2010.
[8] U.S. EPA, *Guidance Concerning Implementation of the 1-hour NO2 NAAQS for the Prevention of Significant Deterioration Program,* Memorandum, EPA's New Source Review Policy & Guidance Web page, June 29, 2010.
[9] U.S. EPA, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS.* Memorandum, EPA's New Source Review Policy & Guidance Web page, March 1, 2011.

Table 1-1
Summary of Applicable PSD SILs and Standards

Pollutant	Averaging Period	Class II SIL ($\mu g/m^3$)	Significant Monitoring Concentrations ($\mu g/m^3$)	National Ambient Standards (NAAQS/ WAAQS) ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Class I PSD Increment ($\mu g/m^3$)
NO_2	1-Hour	7.5*	--	188	--	--	--
	Annual	1	14	100	25	0.1	2.5
SO_2	1-Hour	7.8*	--	195	--	--	--
	3-Hour	25	--	1300	512	1.0	25
	24-Hour	5	13	365/260	91	0.2	5
	Annual	1	--	80/60	20	0.1	2
PM_{10}	24-Hour	5	10	150	30	0.3	8
	Annual	1	--	--	17	0.2	4
$PM_{2.5}$	24-Hour	1.2	4	35	9	0.07	2
	Annual	0.3	--	15	4	0.06	1
CO	1-Hour	2,000	--	40,000	--	--	--
	8-Hour	500	575	10,000	--	--	--

*Notes: The 1-hour Class II NO_2 and SO_2 SILs are interim values published by EPA on June 29, 2010 and August 2010, respectively. The $PM_{2.5}$ increments become effective October 20, 2011.

The following subsections describe the general approach discussed in U.S. EPA's *New Source Review Workshop Manual*, Draft - October 1990, with the changes recommended in the 2010 and 2011 EPA guidance documents.

1.2.2 Class I and II Area Significant Impact Analyses

Significant impact analyses estimate the ambient impacts from the proposed project (including contemporaneous emissions increases and decreases), for those pollutants with net actual emission increases above the Significant Impact Levels (SILs). The results of the significant impact analysis determine whether a cumulative impact analysis (including emissions from other nearby sources) must be performed. If the ambient impacts from the proposed project are less than the SIL for a particular pollutant and averaging period, then no additional modeling needs to be performed to meet Federal New Source Review (NSR) permitting requirements.

SILs for the PSD pollutants are presented above in Table 1-1. The 1-hour NO_2 SIL has not yet been finalized by EPA, therefore, as EPA has recommended, an interim NO_2 SIL equal to 4% of the NAAQS was used in the modeling demonstrations.

1.2.3 Class I and II Area Cumulative Impact Analyses

Cumulative impact analyses are performed to assess compliance with the applicable standard for any pollutant/averaging period for which the project results in significant impacts. These analyses include NAAQS/WAAQS and PSD Increment for Class II areas. PSD Increment analyses for Class I areas were not required (see Section 11.6).

1.2.4 WDEQ-AQD Inhalation Risk Assessment

An inhalation risk assessment for Hazardous Air Pollutants (HAP) is required per WDEQ-AQD guidance. Per this guidance, a Tier 1 (screening level) analysis is performed to estimate the chronic carcinogenic risks for the project. The analysis follows the facility–specific assessment guidance developed by EPA as described in the document *Air Toxics Risk Assessment Reference Library, Volume 2, Facility Assessment*. The analysis uses the AERMOD model and base receptor grid per additional WDEQ-AQD guidance.

1.3 Model Design Concentrations

EPA has defined the dispersion model outputs or "design concentrations" that are compared to the SILs, NAAQS/WAAQS, and PSD Increments. EPA also recommends in GAQM Section 8.3.1.2 that the air quality modeling analyses should evaluate either 5 years of National Weather Service meteorological data or at least 1 year of site-specific meteorological data. These analyses use 3 years of site-specific data (see Section 9 for details). Consequently, the modeled design concentrations are based on GAQM Section 7.2 recommendations and the recent EPA $PM_{2.5}$ and 1-hr NO_2 modeling guidance memos, as discussed below.

1.3.1 Significant Impact Analyses

For the Class II Area significant impact analyses, the modeled concentrations that were compared to the SILs are the highest concentrations over the proposed 3-year meteorological period.

For the Class I Area significant impact analyses, maximum AERMOD predictions at a distance of 50 km from the modeled sources in all directions were compared to the Class I Area SILs. This type of screening analysis was used to determine that CalPuff modeling is not necessary for the Class I PSD Increment analysis.

1.3.2 Cumulative NAAQS Analyses

The modeled design concentrations for the cumulative impact analyses are described below:

- For CO NAAQS, the 1-hour and 8-hour design concentration is the highest, second-highest concentration from each of the individual years that are modeled;

- For NO_2, the annual NAAQS design concentration is the highest of the annual averages calculated from each of the individual years. The 1-hour NO_2 NAAQS design concentration is the highest 98th percentile of the annual distribution of daily maximum 1-hour concentrations, averaged on a receptor-by-receptor basis across the number of years modeled. Alternatively, the highest, 8th-high (H8H) value may be used initially, since it is more conservative than the 98^{th} percentile of daily max 1-hour concentrations;

- For SO_2, the annual NAAQS design concentration is the highest of the annual averages calculated from each of the individual years. The 3-hour and 24-hour design values are the highest, second-highest concentration from each of the individual years modeled. The 1-hour SO_2 NAAQS design concentration is the highest 99th percentile of the annual distribution of daily maximum 1-hour concentrations, averaged on a receptor-by-receptor basis across the number of years modeled. Alternatively, the highest, 4th-high (H4H) value may be used initially, since it is more conservative than the 99th percentile of daily max 1-hour concentrations;

- For PM_{10}, the 24-hour NAAQS design concentration is the "n+1" highest concentration over the "n" year modeling period (high 4th highest for the three year meteorological data set). The 24-hour PSD Increment design concentration is the highest, second-highest concentration calculated from each of the individual years that are modeled. The PSD annual increment design concentration is the highest of the individual annual averages; and

- For $PM_{2.5}$, the 24-hour and annual design concentrations were based on the latest EPA guidance memorandum titled "*Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS*", Steven Page, EPA OAQPS, March 23, 2010. For the 24-hour NAAQS design concentration, the highest 24-hour $PM_{2.5}$ concentration was determined for each of the 3 years modeled. For conservatism, the highest 24-hour value over the entire 3 year period was selected as the design concentration. For the annual average NAAQS design concentration, the highest modeled annual concentration over the three years was considered as the design concentration.

1.3.3 PSD Increment Analyses

The Class II PSD Increments are maximum allowable increases in concentrations that may be exceeded once per year at each site, except for the annual increment which may not be exceeded at all. Therefore, for short-term averages the highest, second-highest short term average concentration for any year is the design concentration, and for annual averages the design concentration is the highest modeled annual average. For the Class I area PSD Increment analysis, the highest short term and annual concentration for any year will be the design concentration for comparison with the Class I increments.

A summary of the applicable Class I and II SILs, PSD Increments, and NAAQS is provided in Table 1-1.

1.4 Proposed Modeling Procedures for Individual Pollutants

The following Subsections 1.4.1 through 1.4.5 discuss the general modeling approach for each pollutant evaluated.

1.4.1 NO_2 1-hour and Annual Modeling

The standard approach discussed in the U.S. EPA NSR Workshop Manual will be used for the annual NO_2 modeling.

For the 1-hour NO_2 analysis, the interim SIL proposed by the U.S. EPA is 4 ppb (approximately 7.5 μg/m^3). A multi-step approach for NO_2 1-hour average modeling was conducted.

Step 1 (Significant Impact Modeling). In the first step, all project-related and contemporaneous period increases and decreases were modeled. Full conversion from NO_x to NO_2 was assumed. The modeling was conducted on a receptor grid described in Section 8, using three years of onsite meteorological data. In this step, the maximum modeled value was compared to the SIL of 7.5 $\mu g/m^3$ for the 1-hour average. A receptor grid containing all receptors with maximum modeled concentrations over the SIL was constructed for use in the Cumulative Impact Modeling. Additional discussion of the receptor grids to be used in cumulative impact analyses is provided in Section 8.

Step 2 (Cumulative Impact Modeling). In this step, on-site existing and off-site sources of NO_x were added to the modeling. A discussion regarding the development of the inventory of off-site sources is provided in Section 5.3. The eighth-highest maximum daily values were averaged over the three-year period on a receptor by receptor basis. The Ambient Ratio Method (ARM) was applied to adjust for conversion of NO_x to NO_2.

The monitored NO_2 background concentration described in Section 5.4 was added to the design values predicted from the Step 2 modeling. The results of the Step 2 modeling were added to the background concentration for comparison to the NAAQS/WAAQS. Compliance was shown at all receptors.

1.4.2 SO_2 Modeling

The standard approach discussed in the U.S. EPA NSR Workshop Manual was used for the annual, 3-hour and 24-hour SO_2 modeling.

For the 1-hour SO_2 analysis, the interim SIL proposed by the U.S. EPA is 4 ppb (approximately 7.8 $\mu g/m^3$). A multi-step approach for SO_2 1-hour average modeling was conducted.

Step 1 (Significant Impact Modeling). In the first step, all project-related and contemporaneous period increases and decreases were modeled. The modeling was conducted on a receptor grid described in Section 8, using three years of onsite meteorological data. In this step, the maximum modeled value was compared to the SIL of 7.5 $\mu g/m^3$ for the 1-hour average. A receptor grid containing all receptors with maximum modeled concentrations over the SIL was constructed for use in the Cumulative Impact Modeling. Additional discussion of the receptor grids to be used in cumulative impact analyses is provided in Section 8.

Step 2 (Cumulative Impact Modeling). In this step, on-site existing and off-site sources of SO_2 were added to the modeling. A discussion regarding the development of the inventory of off-site sources is provided in Section 5.3. The fourth-highest maximum daily values were averaged over the three-year period on a receptor by receptor basis.

The monitored SO_2 background concentration described in Section 5.4 was added to the design values predicted from the Step 2 modeling. The results of the Step 2 modeling were added to the background concentration for comparison to the NAAQS/WAAQS. Compliance was shown at all receptors.

No receptors were shown to be significant for the annual SO_2 modeling. This analysis was deemed complete at this step and a full impact analysis was not performed.

1.4.3 CO 1-hour and 8-hour Average Modeling

The standard approach discussed in the U.S. EPA's *NSR Workshop Manual* (1990) was used for the CO modeling. As discussed in Section 11.3, the model predictions were below the NAAQS/WAAQS for both averaging periods.

1.4.4 PM_{10} 24-hour and Annual Average Modeling

For PM_{10} 24-hour and annual NAAQS and increment analyses, the modeling was conducted in agreement with the modeling procedures provided in the U.S. EPA's *NSR Workshop Manual* (1990). The highest, first-high model impacts from the project and contemporaneous sources were used in the significant impact modeling. As discussed in Section 11.4, the model predictions were below the SILs for both averaging periods; therefore, cumulative Full Impact and Increments analyses were not required for this pollutant.

1.4.5 $PM_{2.5}$ 24-hour and Annual Average Modeling

Issues related to implementing the NSR program for $PM_{2.5}$ were addressed in a memorandum dated March 23, 2009, *Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS*. The main issue was related to elimination of the "PM_{10} as a surrogate" policy in favor of an explicit $PM_{2.5}$ analysis. The steps discussed in Section 1.4.1 (regarding 1-hour NO_2 modeling) were also utilized for the $PM_{2.5}$ modeling, with the following modifications:

- In Step 1, the modeling results were compared to the SILs established by the U.S. EPA on September 29, 2010 (i.e., 1.2 $\mu g/m^3$ for 24-hour average and 0.3 $\mu g/m^3$ for annual average);
- $PM_{2.5}$ emissions were conservatively assumed equal to PM_{10} emissions from all modeled sources except the FCCU Regenerator Vent;
- The design values for $PM_{2.5}$ described in Sections 1.3.1 and 1.3.2 were utilized;
- The $PM_{2.5}$ background concentrations described in Section 5.4 were used in the NAAQS analyses.

The highest, first-high model impacts from the project and contemporaneous sources were used in the significant impact modeling. As discussed in Section 11.5, the model predictions were below the SILs for the annual averaging period; therefore, cumulative Full Impact analyses were not required for this averaging time. A Full Impact analysis was conducted for the 24-hr averaging period. NAAQS/WAAQS compliance was shown at all receptors.

SECTION 2
MODEL SELECTION

The latest code (version 11103) of the U.S. EPA approved AERMOD model was used to predict pollutant concentrations. A commercial version of the model (BEEST for Windows by Bee-Line Software); was used as the modeling interface. In this analysis, modeling with AERMOD was performed using the regulatory default options, which includes stack heights adjusted for stack-tip downwash, buoyancy-induced dispersion, and final plume rise. Ground-level concentrations occurring during "calm" wind conditions are calculated by the model using the calm processing feature.

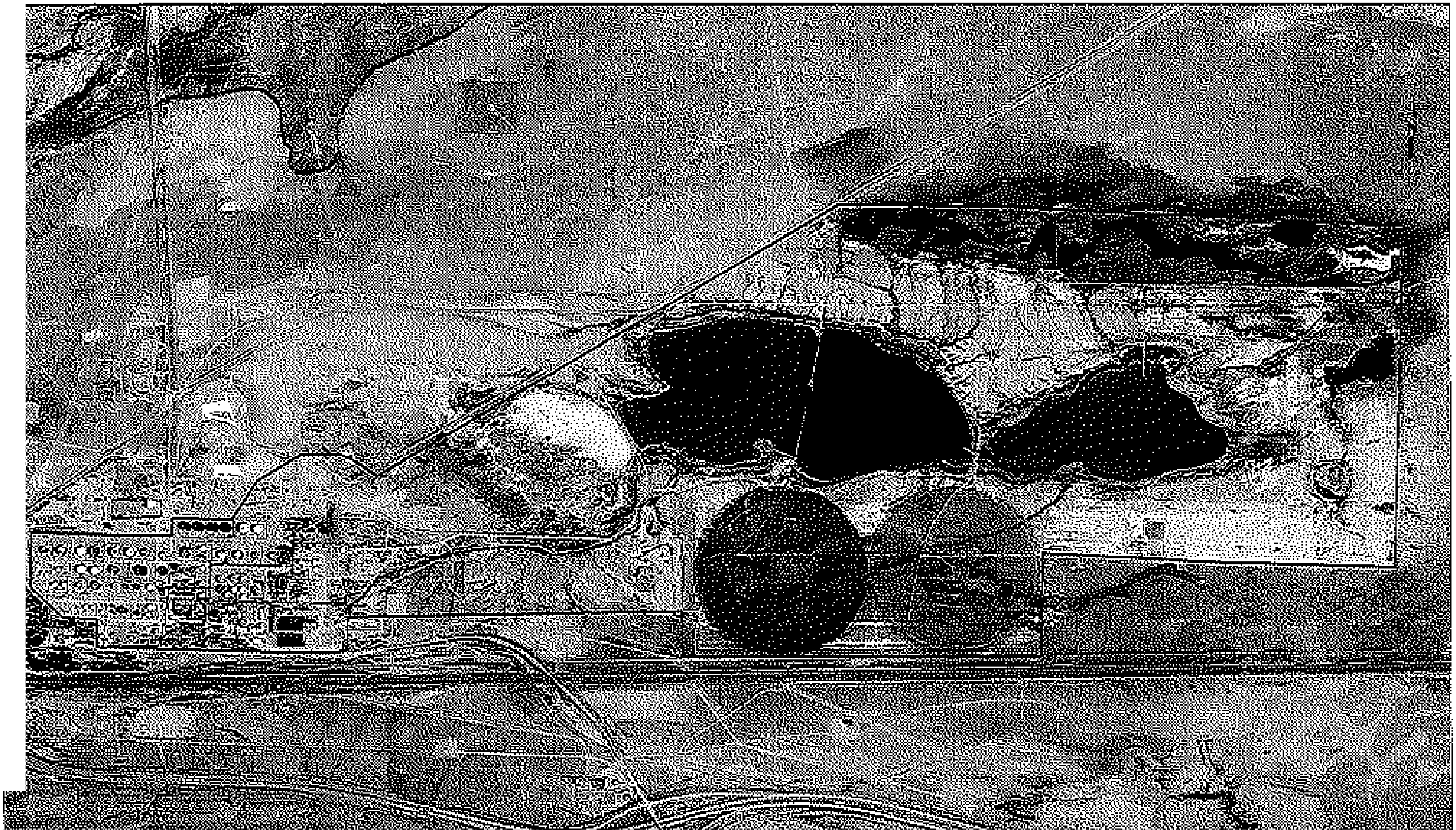
As discussed in Section 1, the new NO_2 and $PM_{2.5}$ standards are probabilistic, which requires post-processing of initial modeling results to demonstrate compliance with the standards. The new AERMOD version fully incorporated in BEEST for Windows software includes processors to calculate the required statistical probabilities of NO_2 and $PM_{2.5}$ concentrations as prescribed in the U.S. EPA's guidance[10,11]. More details regarding the post-processing procedures are provided in Section 10.

[10] U.S. EPA, *Notice Regarding Modeling for New Hourly NO2 NAAQS*. February 25, 2010 (Updated).
[11] U.S. EPA, *Modeling Procedures for Demonstrating Compliance with PM2.5 NAAQS*. March 23, 2010.

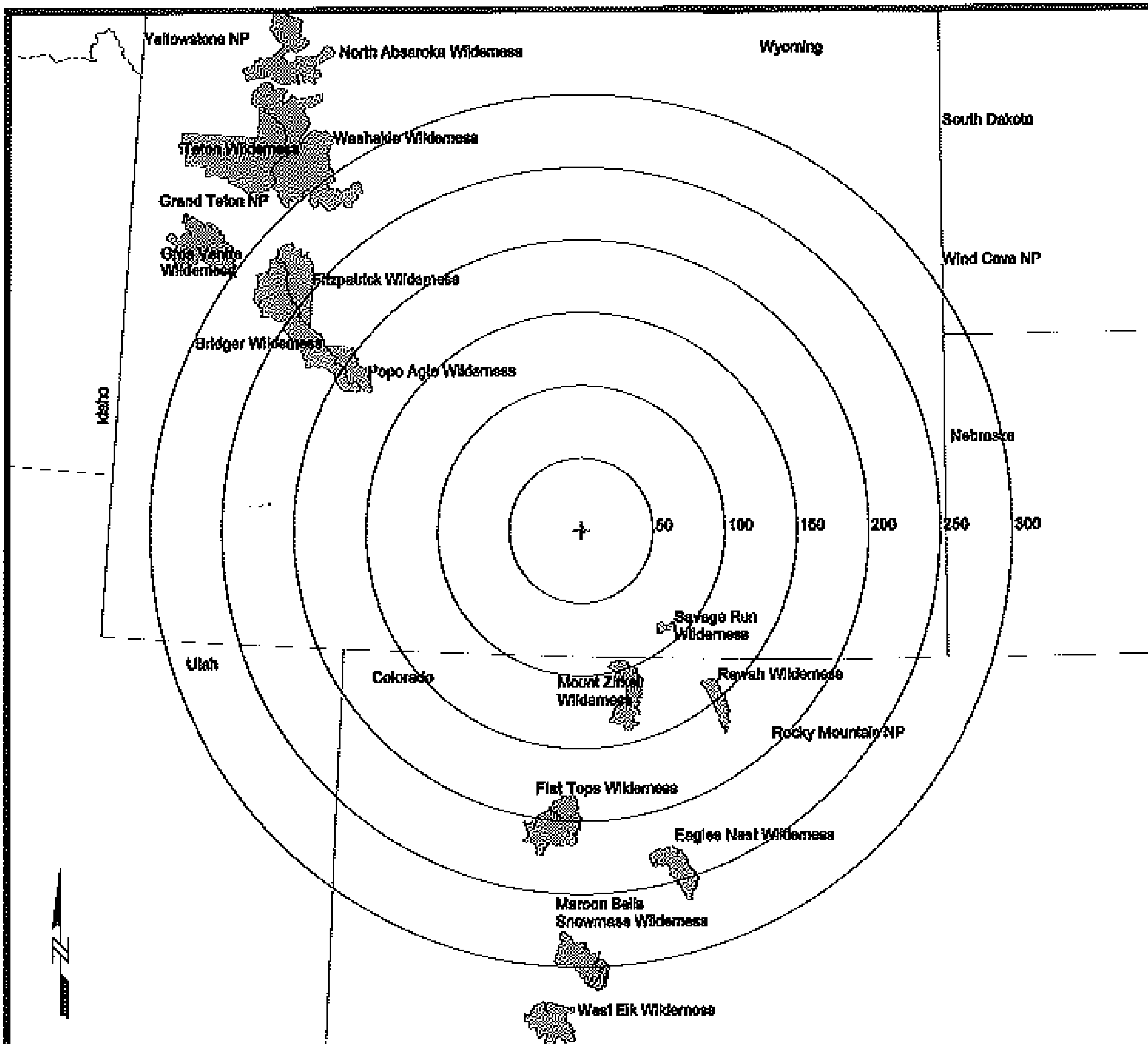
SECTION 3
SITE LOCATION

A drawing showing the SWRC ambient boundary overlaid on an aerial photo is shown in Figure 3-1.

An image showing the relative location of SWRC to the nearby Class I areas is depicted in Figure 3-2. The Class I areas nearest to the facility are the Savage Run Wilderness Area (75 kilometers) and the Mount Zirkel Wilderness Area (92 km). All other Class I areas are greater than 100 kilometers from SWRC.



Sinclair Wyoming Refining Company	SAGE ENVIRONMENTAL CONSULTING	Figure: 3-? Appendix: C Date: September, 2011 Report No: 400.111.2.33



Scale

0 15 30 60 90 120 150 180 210 240 270 300 Kilometers

Legend

Sinclair Wyoming Refinery

NPS Class I Areas

USFS Class I Areas

WY Wilderness Areas

Sinclair Wyoming Refinery Location with Corresponding Nearby PSD Class I Areas

SAGE ENVIRONMENTAL CONSULTING

Sage Environmental Consulting, LP

Figure:	3-2
Revision #:	0
Date:	September, 2011
Project No:	400.111.2.33

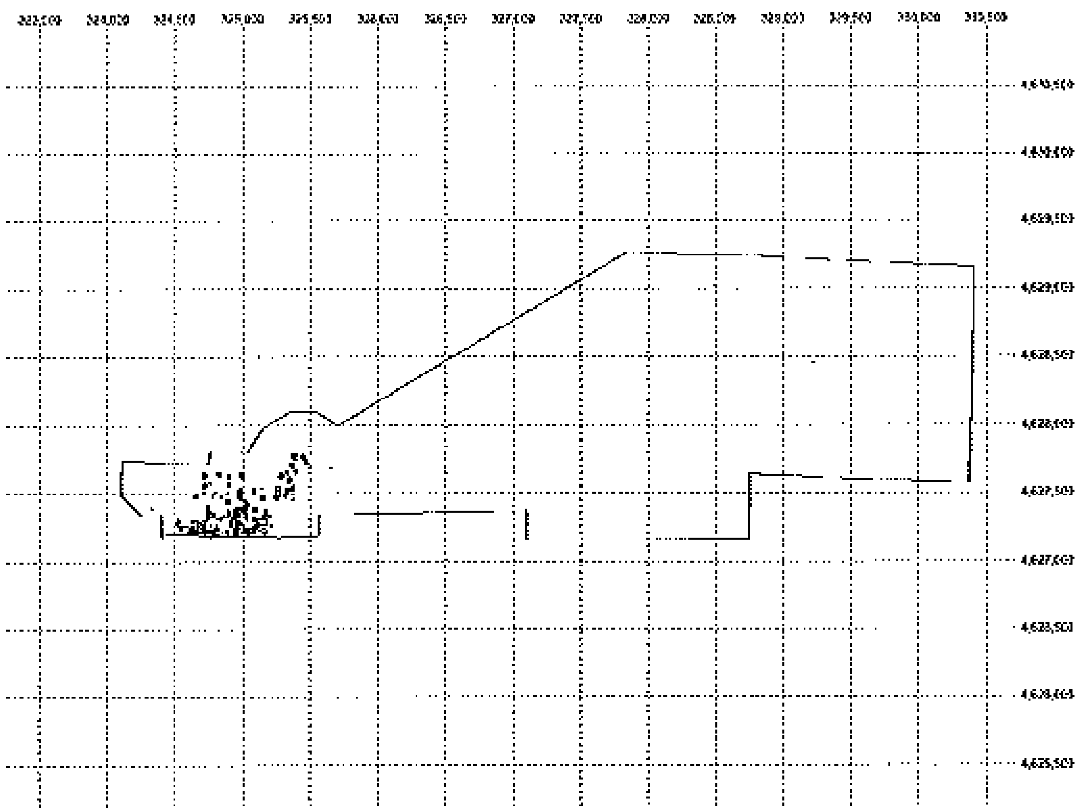
SECTION 4
PLOT PLAN

The equipment affected by this project is located at the existing SWRC refinery in Sinclair, Carbon County, Wyoming. All sources are located within the Ambient Air Boundary shown in Figure 3-1. This revised boundary was approved via an August 9, 2011 letter from WDEQ-AQD. The location of the emission sources and buildings relative to the boundary are shown in Figure 4-1.

In all modeling input and output data files, the location of emission sources, structures, and receptors are represented in the Universal Transverse Mercator (UTM) coordinate system. All UTM coordinates used in the modeling are based on the North American Datum of 1927 (NAD27).

All emission units, buildings, structures, and property boundary locations digitized from plot plans and/or land surveys were converted to equivalent UTM coordinates. SWRC's rectangular buildings and structures and their corresponding UTM coordinates are presented in Appendix A.

Figure 4-1
Location of the SWRC Buildings and Sources Relative to the AAB



SECTION 5
MODELING EMISSIONS INVENTORY

SWRC evaluated and quantified hourly and annual emissions for all applicable pollutants associated with the project. Detailed emission calculations are provided in the permit application package.

Emission sources included in the modeling input files are specific to each type of modeling (i.e., Significant Impact; Cumulative Impact; PSD Increment, and Inhalation Risk Assessment, as applicable). The source selection is addressed in the following subsections, which provide a brief description of the modeling setup for the emission sources and the source groupings.

5.1 Significant Impact Modeling Sources

Significant Impact Modeling was conducted to determine the Significant Impact Area (SIA), i.e., the area in which receptors must be located to evaluate compliance with NAAQS and PSD Increment standards. The PSD Step 1 analyses were completed for NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10}.

To determine whether Cumulative Impact Modeling, PSD Increment modeling, and/or pre-construction and post construction ambient air monitoring for NO_2, SO_2, CO, $PM_{2.5}$ or PM_{10} is required, modeling of emissions from the project related increases, as well as all emissions increases and decreases during the PSD contemporaneous period[12] was conducted to determine if the predicted concentrations equal or exceed the SILs listed in Table 1-1 for each respective pollutant and averaging period. If a SIL was exceeded for a particular pollutant-averaging period combination, a significant impact area (SIA) was defined as all receptors with a design value that exceeds the SIL.

Tables showing the source parameters specific to each modeled source included in this step of the analysis are presented in Appendix B. These tables include UTM coordinates, emissions rates, and release parameters for each modeled pollutant and emission source.

5.2 Cumulative Impact Modeling - On-site Sources

NAAQS and PSD Increment Full Impact Modeling (FIM) analyses were conducted for the pollutants with significant impacts from the project and contemporaneous period sources. All on-site sources were included in this step of the modeling analysis at maximum permitted emission levels.

Tables showing the source parameters specific to each modeled source are presented in Appendix C. These tables include UTM coordinates, emissions rates, and release parameters for each modeled pollutant and emission source.

[12] *New Source Review Workshop Manual. Prevention of Significant Deterioration and Nonattainment Area Permitting*, Section C.IV.B. U.S. EPA, Office of Air Quality Planning and Standards. October 1990.

5.3 Cumulative Impact Modeling - Off-property Sources and Parameters

The inventory of off-site sources was based on historical cumulative modeling analyses performed by SWRC as well as updated information recently provided by WDEQ-AQD.

Tables showing the source parameters specific to each modeled source are presented in Appendix C. These tables include UTM coordinates, emissions rates, and release parameters for each modeled pollutant and emission source.

5.4 Background Concentrations

Background concentrations for the NAAQS/WAAQS analyses were provided by WDEQ-AQD in their comments on the protocol, received via electronic mail on September 20, 2011. A summary of the background monitored values used in the analyses is provided in Table 5-1.

Table 5-1
Background Concentrations Used in Modeling

Sinclair Crude Optimization Project Background Concentrations (WDEQ AP#12242)		
Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)
NO_2	1-Hour	32.1
	Annual	5.7
SO_2	1-Hour	20.8
	3-Hour	15.6
	24-Hour	5.2
	Annual	2.7
$PM_{2.5}$	24-Hour	9
	Annual	4.2
PM_{10}	24-Hour	62
	Annual	15

Notes:

1) NO_2 background from 2008-2010 data from the AQD's Murphy Ridge site. 1-hour background: 3-year average of the 98th percentile of the daily maximums* (0.017 ppm); annual background: highest annual mean (0.003 ppm)

2) 1-Hour SO_2 background is the 99th percentile of the annual distribution of daily maximums (0.008 ppm) from the AQD's Wamsutter site for 2008-2009

3) 3-Hour SO_2 background is the 2nd high 3-hour (0.006 ppm) from the AQD's Wamsutter site for 2008-2009

4) 24-Hour SO_2 background is the 2nd high 24-hour (0.002 ppm) from the AQD's Wamsutter site for 2008-2009

5) Annual SO_2 background is the highest annual mean (0.001 ppm) from the AQD's Wamsutter site for 2008-2009

6) 24-Hour $PM_{2.5}$ background is the 3-year average of the 98th percentile of the 24-hour averages** from the AQD's Cheyenne site (2008-2010)

7) Annual $PM_{2.5}$ background is the 3-year average of the annual means** from the AQD's Cheyenne site (2008-2010)

8) 24-Hour PM_{10} background is the average of the highest 2nd-high 24-hour averages from the AQD's Wamsutter site (2008-2010)

9) Annual PM_{10} background is the 3-year average of the annual means from the AQD's Wamsutter site (2008-2010)

* per EPA memo *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard* (T. Fox, 1 Mar 11)

** per EPA memo *Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS* (S. Page, 23 Mar 10)

SECTION 6
LAND USE AND TERRAIN

The land use within a 3-kilometer (km) radius of SWRC was evaluated using current aerial photo images and general knowledge of the area. Rural land use clearly prevails in the area; therefore, the AERMOD-default rural dispersion option was used in this air quality analysis.

The terrain option was used in the modeling to account for the elevation of the on- and off-site sources, receptors, and downwash structures. Base elevations of the facility emission sources, buildings, and all receptors will be obtained from a National Elevation Dataset (NED) file as described below.

An NED file was obtained from the United States Geological Survey (USGS) website[13]. The NED file is a NAD83 elevation file with heights measured in meters. The NED file was used to calculate elevations for all modeled objects (sources, structures, and receptors). A copy of the file is included on the DVD submitted with this report. The NED file has a resolution of 1-arc second.

The terrain elevations were imported into the AERMOD input file using the BEEST for Windows built-in processor that utilizes the latest version of EPA's AERMAP (version 11103) terrain preprocessing program.

[13]http://seamless.usgs.gov/index.php

SECTION 7
BUILDING WAKE EFFECTS (DOWNWASH)

Direction-specific building dimensions and the dominant downwash structure parameters used as input to the AERMOD model were determined using GEP/BPIP-PRIME (Good Engineering Practice/Building Profile Input Program for PRIME) program, version 04274.

Data input for each structure at SWRC was used by the BPIP-PRIME program to calculate the direction-specific downwash parameters. The BPIP-PRIME program generates the height, width and three additional downwash parameters for thirty-six compass directions for each structure with reference to each point source of emissions. BPIP-PRIME also takes into account the difference in the base elevation of the point source and the structure to determine the good engineering practice (GEP) stack height or the height at which the stack will not be affected by downwash from the structure.

The output from BPIP-PRIME contains a summary of the dominant structures for each emission unit (considering all wind directions) and the actual building heights, projected widths, and three additional parameters for 36 wind directions. This information was then incorporated into the input files for the AERMOD model using the BEEST for Windows Suite's built-in functions. The BPIP-PRIME input and output files are provided on a CD accompanying this modeling report.

BPIP structure information is also tabulated in Appendix A.

SECTION 8
RECEPTOR GRIDS

The following sections discuss the receptor grids that were used in the modeling analyses. All receptor coordinates have a datum of NAD27. The receptor elevations for all grids were evaluated using the BEEST for Windows software's built-in processor that utilizes the AERMAP program Version 11103, which processed the NED file covering the modeling domain.

8.1 Receptors for Class I Impact Modeling Analyses

A polar grid was used to conduct the Class I Significant Impact modeling analyses. A set of polar receptors was set up that are arranged in an arc (full circle), with 1 degree spacing, at a distance of 50 kilometers. The location and configuration of these receptors is shown in Figure 8-1.

8.2 Receptors for Class II Preliminary Modeling Analyses

For the criteria pollutant and inhalation risk modeling, the base receptor grid follows the WDEQ-AQD guidance for PSD modeling analyses. It consists of a grid containing:

- 50-m spacing along the facility ambient air boundary
- 100-m spacing from the ambient boundary to a distance of at 1.0 km
- 250-m spacing from 1.0 km to 3.0 km
- 500-m spacing from 3.0 km to 10.0 km
- 1000-m spacing from 10.0 km to 25.0 km

The size of the grid was sufficient in all cases to establish the significant receptors. The location and configuration of these receptors are shown in Figures 8-2 and 8-3.

8.3 Receptors for Class II Cumulative Impact and Increment Modeling Analyses

For Class II Cumulative and Increment modeling analyses, receptor grids were built containing only those receptors exceeding the SIL for each pollutant and averaging time. These reduced receptor grids are shown in Figures 8-4 through 8-11 below.

Figure 8-1
Receptor Grid for Class I Area Modeling

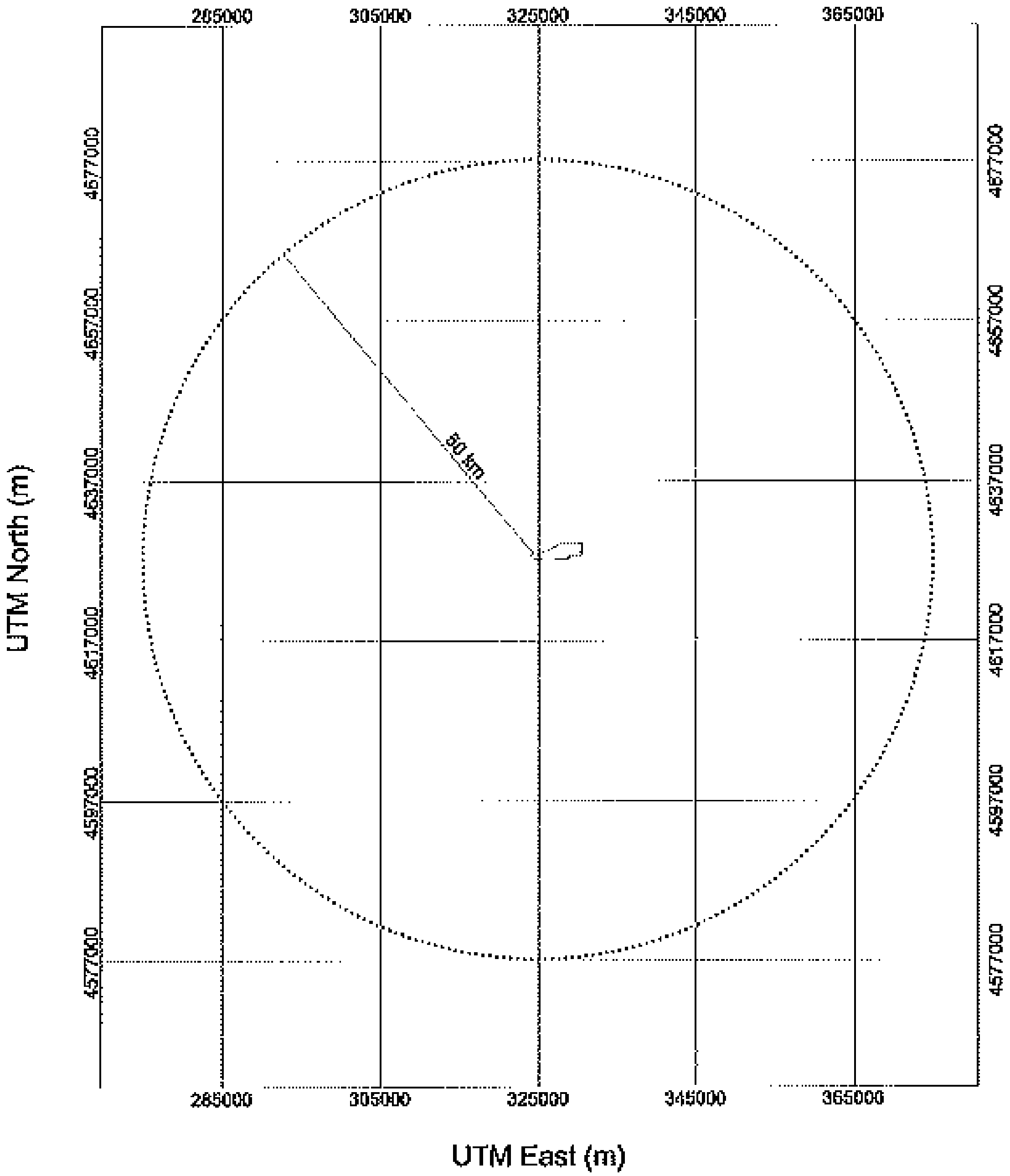


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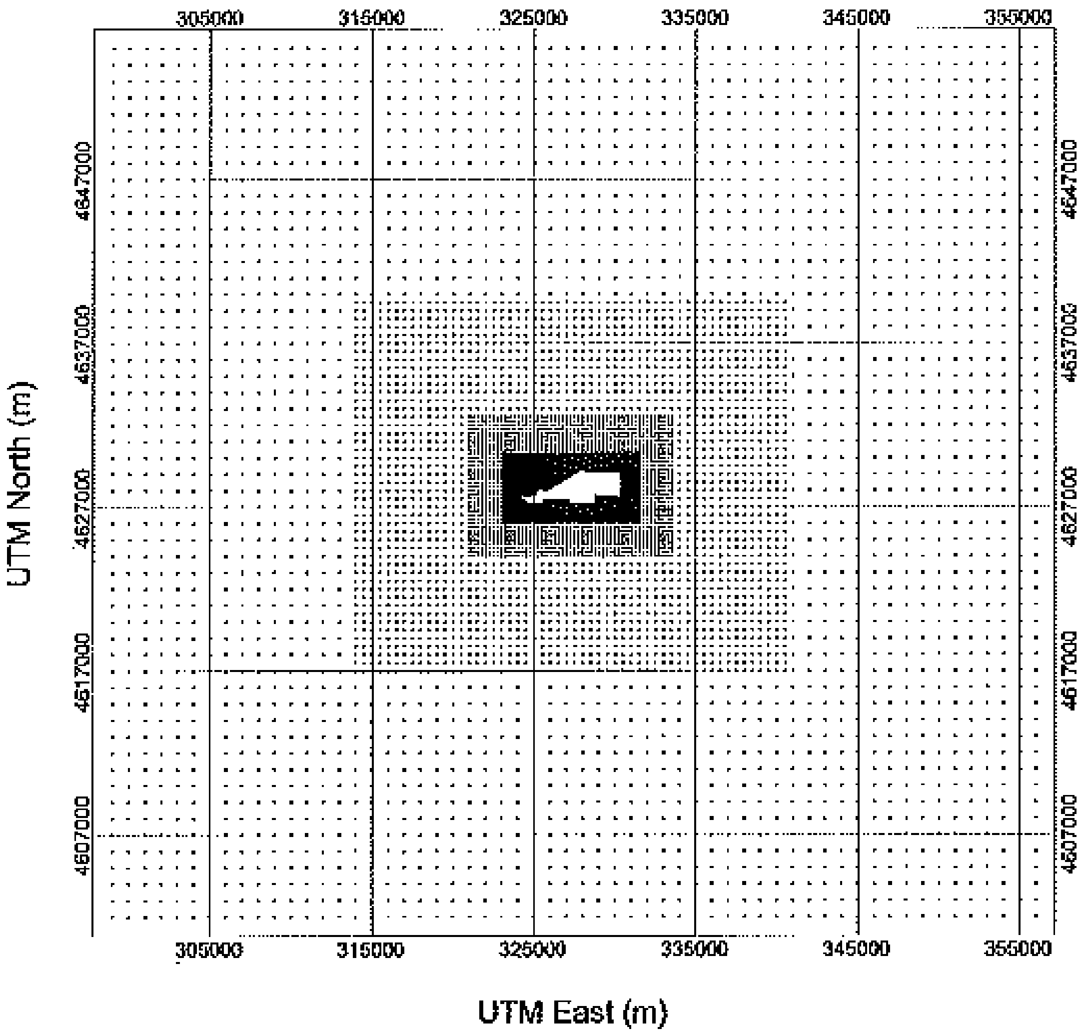
Figure 8-2
Initial Base Receptor Grid



SOLVAY2016_1.2_004689

Figure 8-3
Initial Receptor Grids for Class II Area Modeling (Fenceline Area)

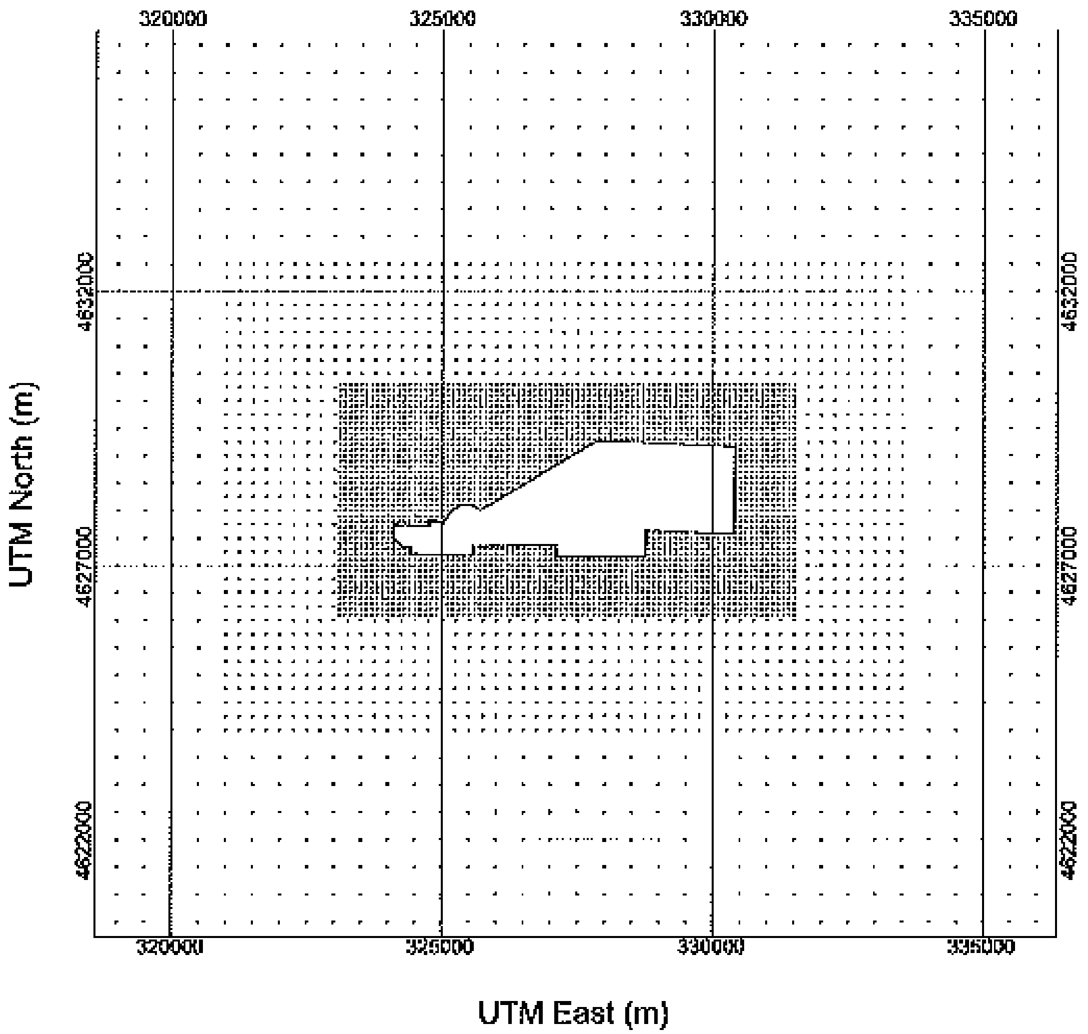


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Figure 8-4
Reduced Receptor Grid for Cumulative 1-hr NO_2

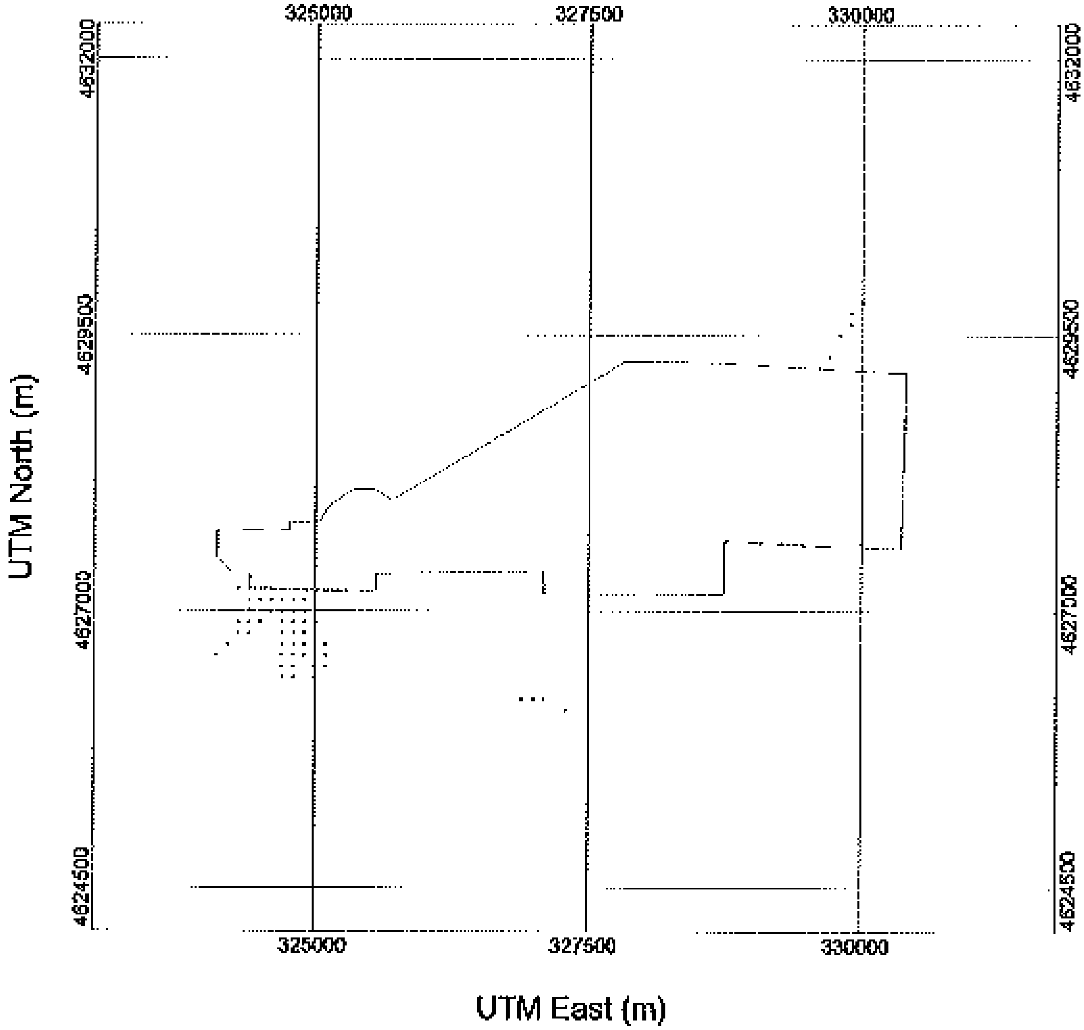

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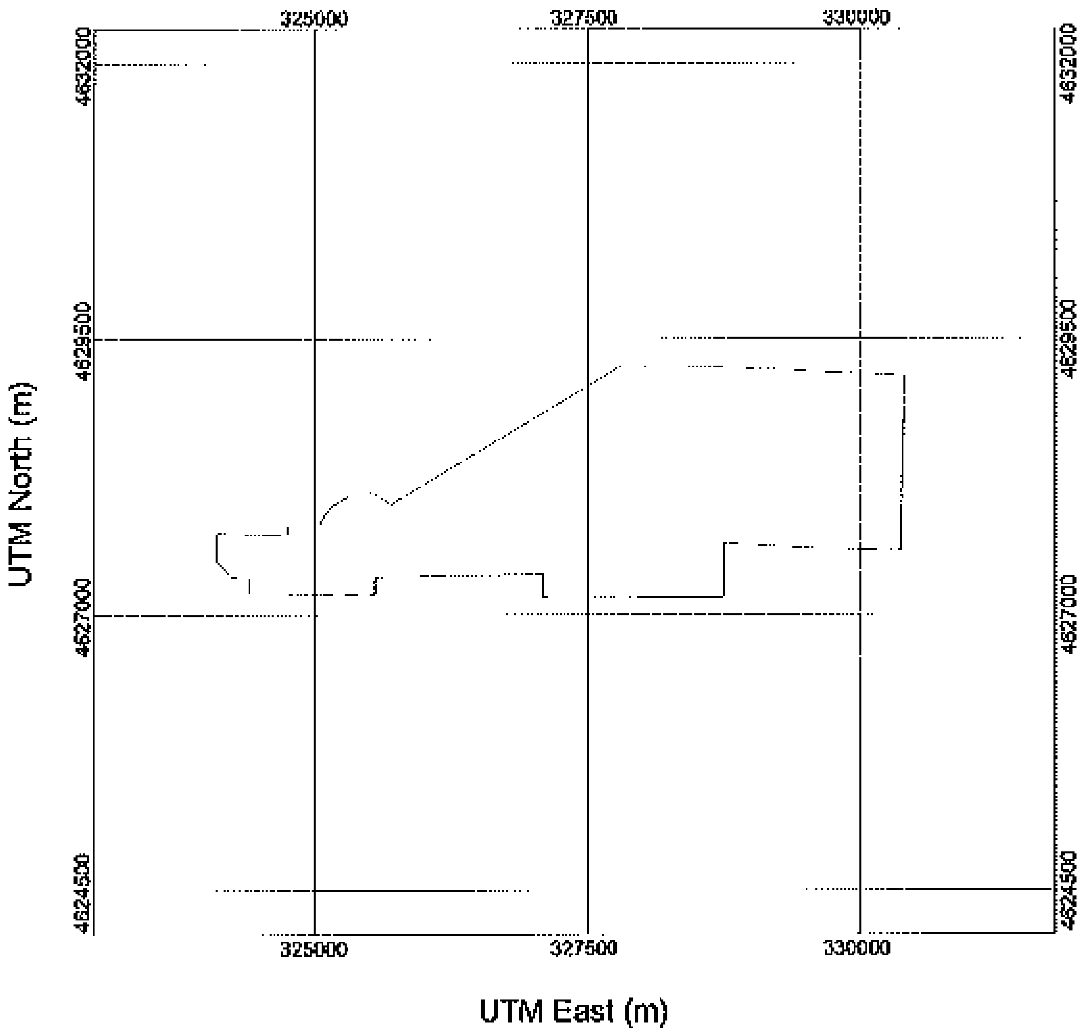
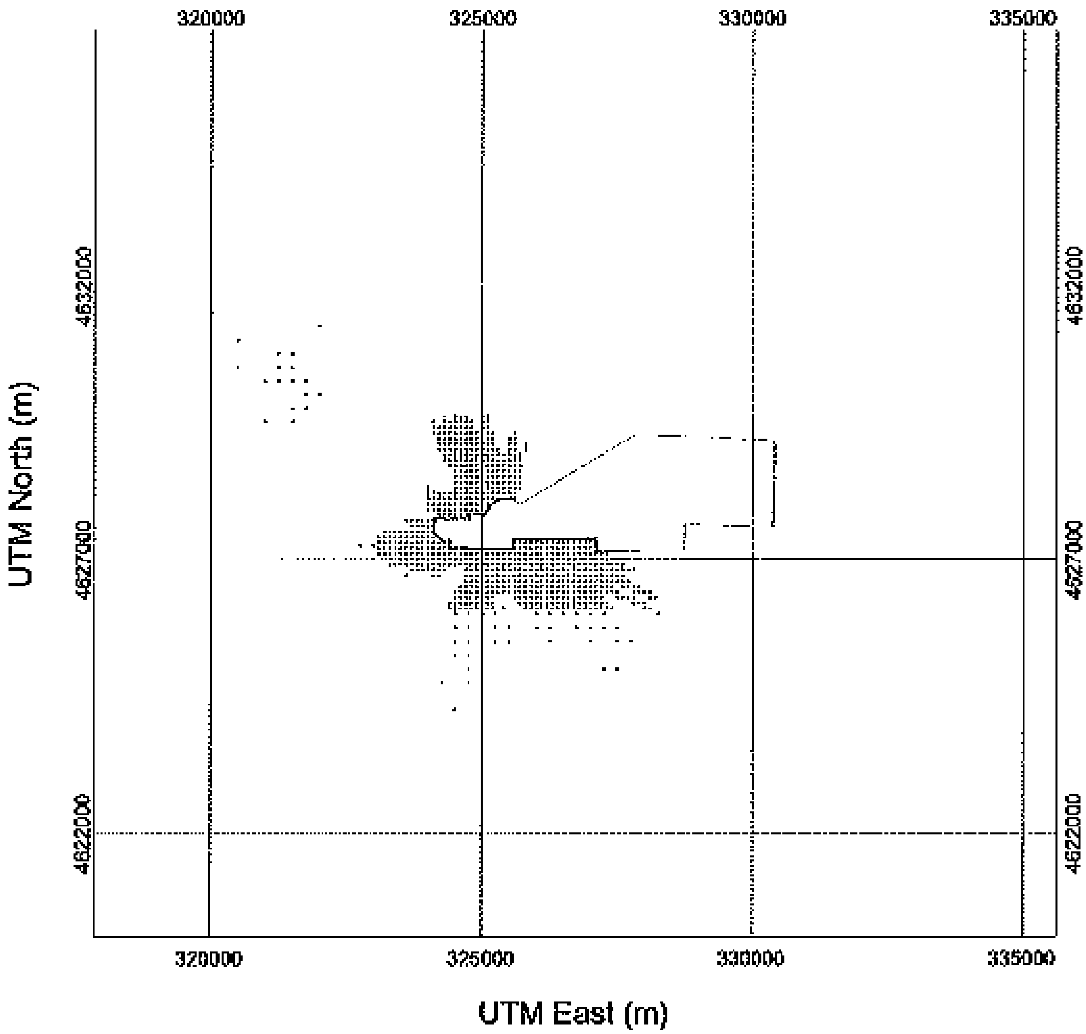
Figure 8-5
Reduced Receptor Grid for Cumulative Annual NO_2



SOLVAY2016_1.2_004692

Figure 8-6
Reduced Receptor Grid for Cumulative 1-hr SO_2



SOLVAY2016_1.2_004693

Figure 8-7
Reduced Receptor Grid for Cumulative 3-hr SO_2

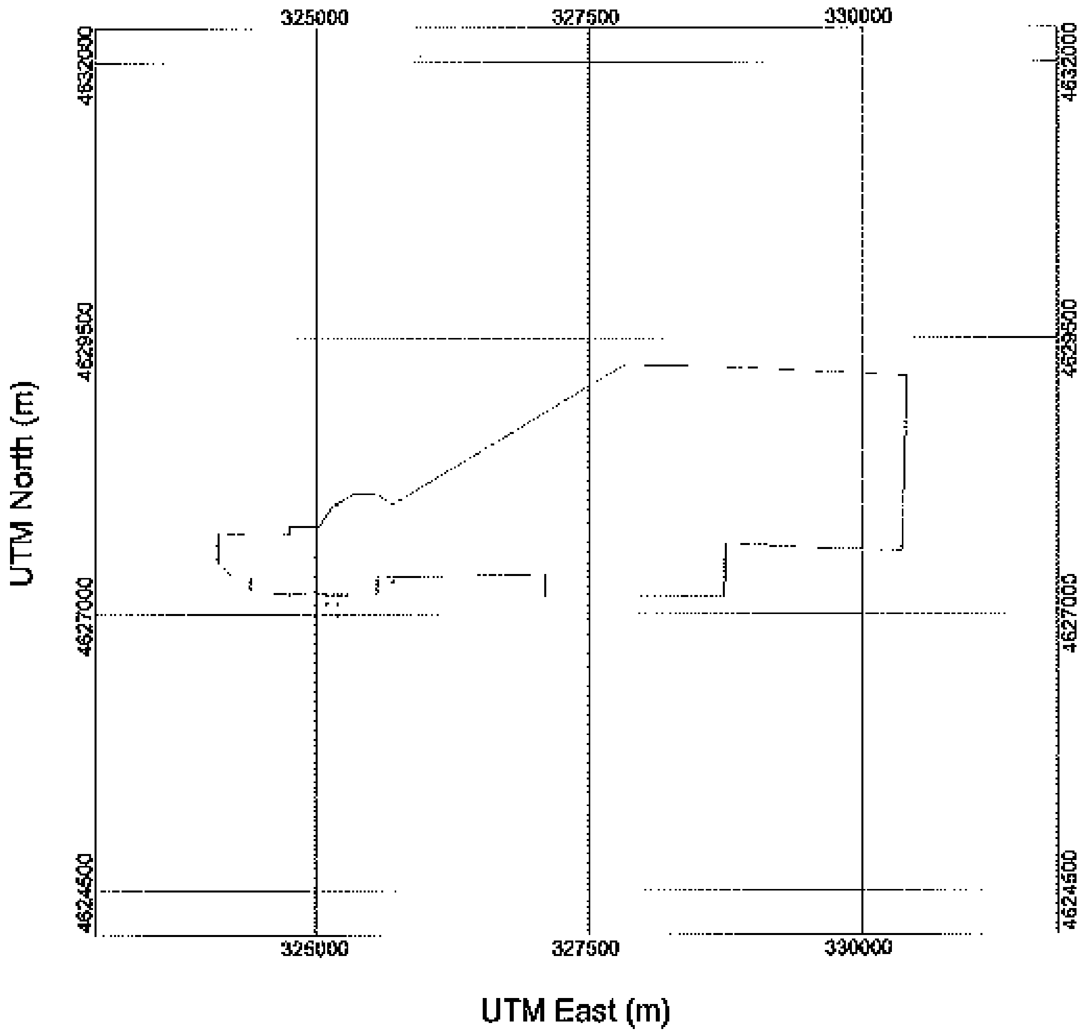


Figure 8-8
Reduced Receptor Grid for Cumulative 24-hr SO_2

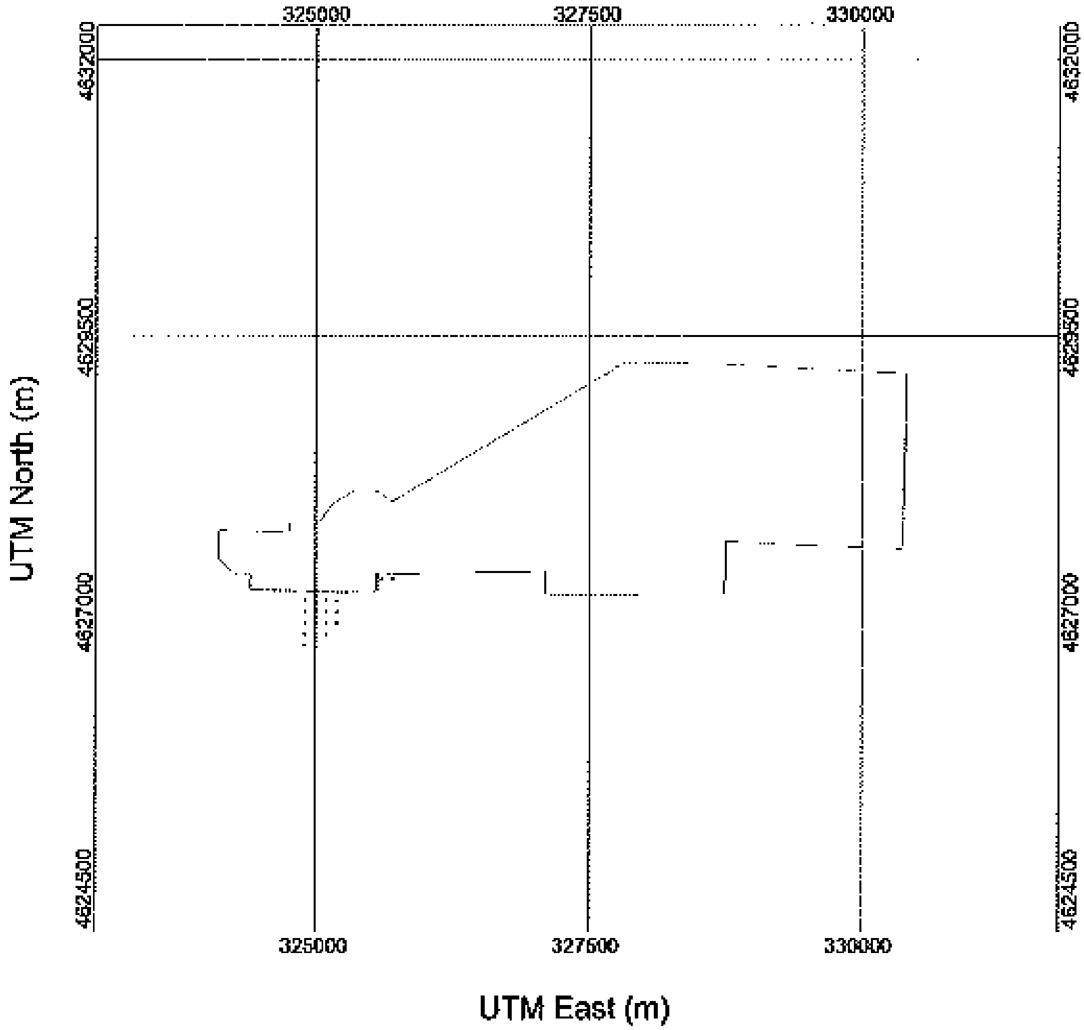


Figure 8-9
Reduced Receptor Grid for Cumulative 24-hr PM_{10}

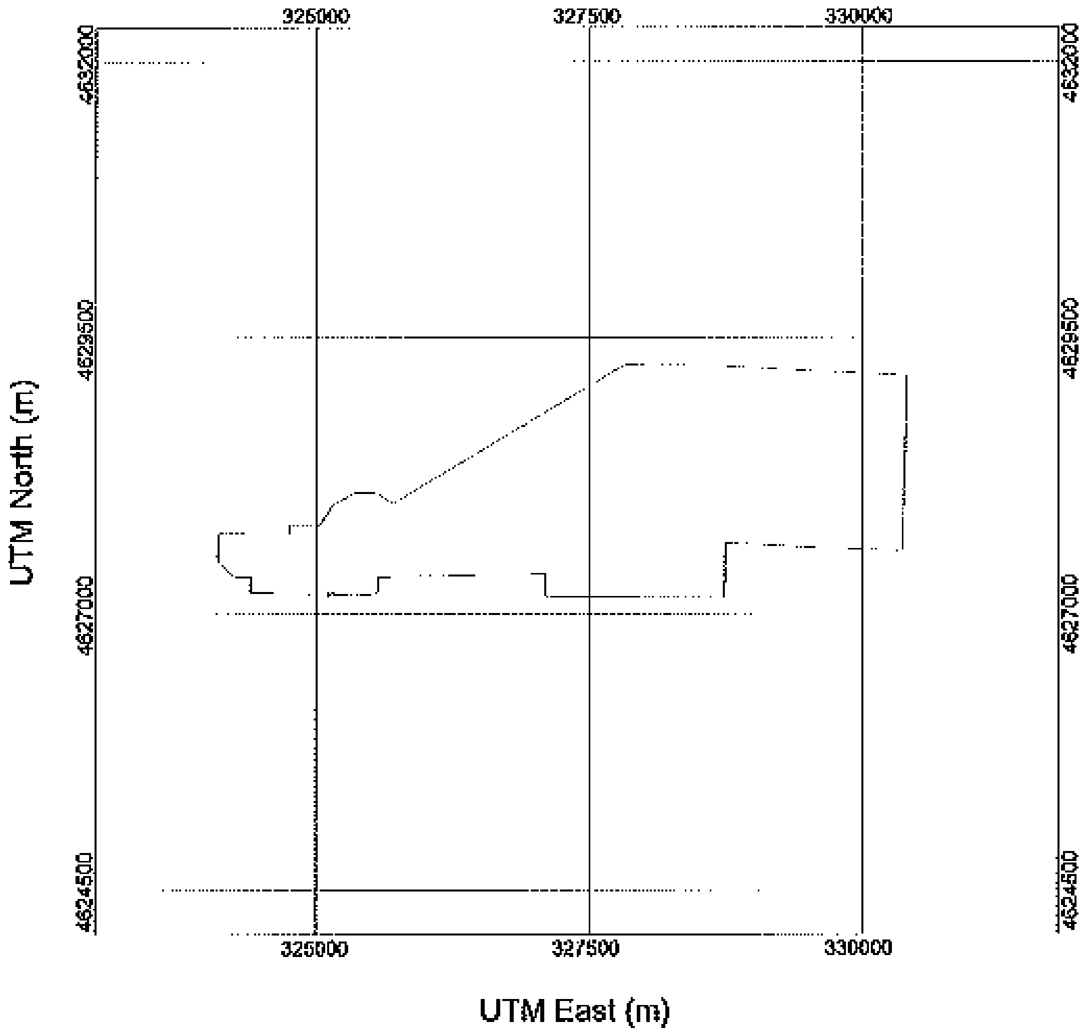
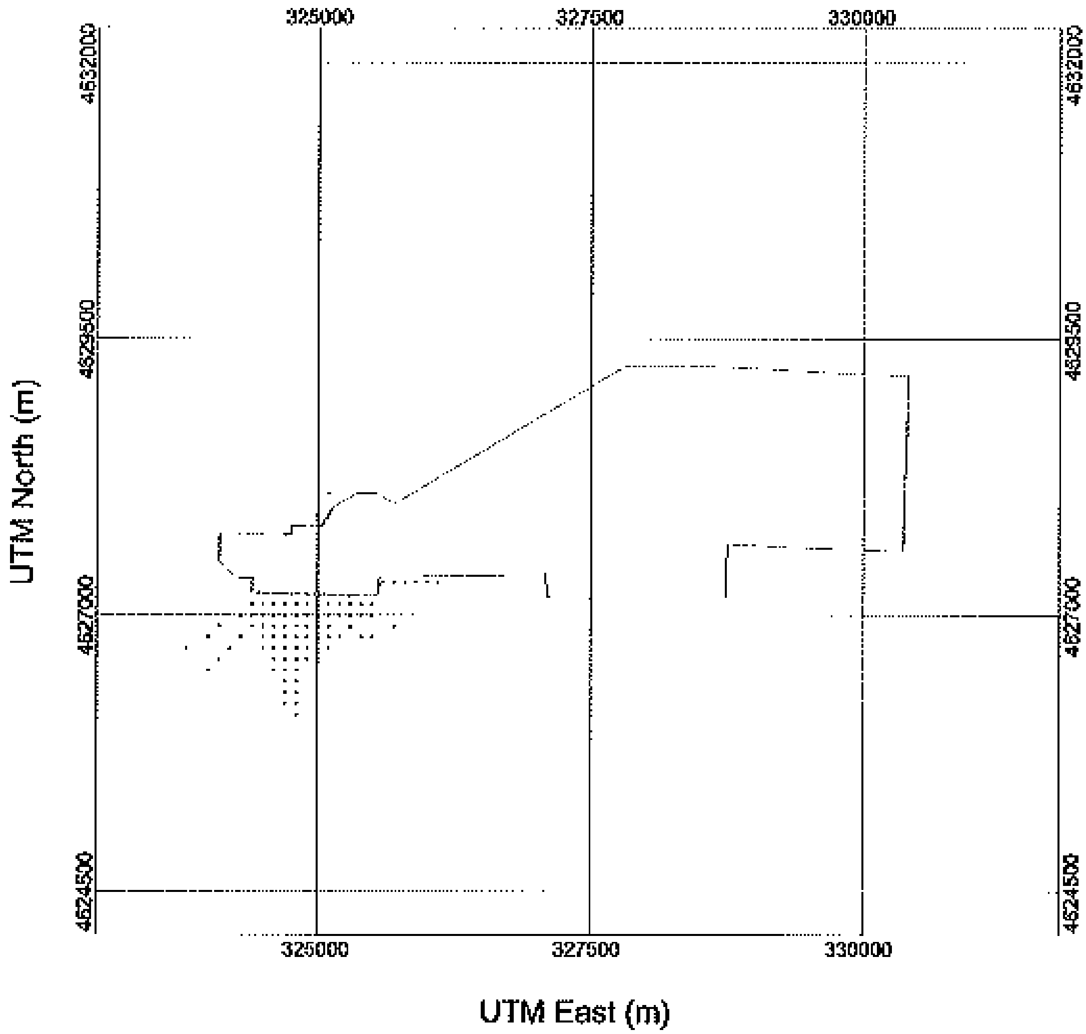
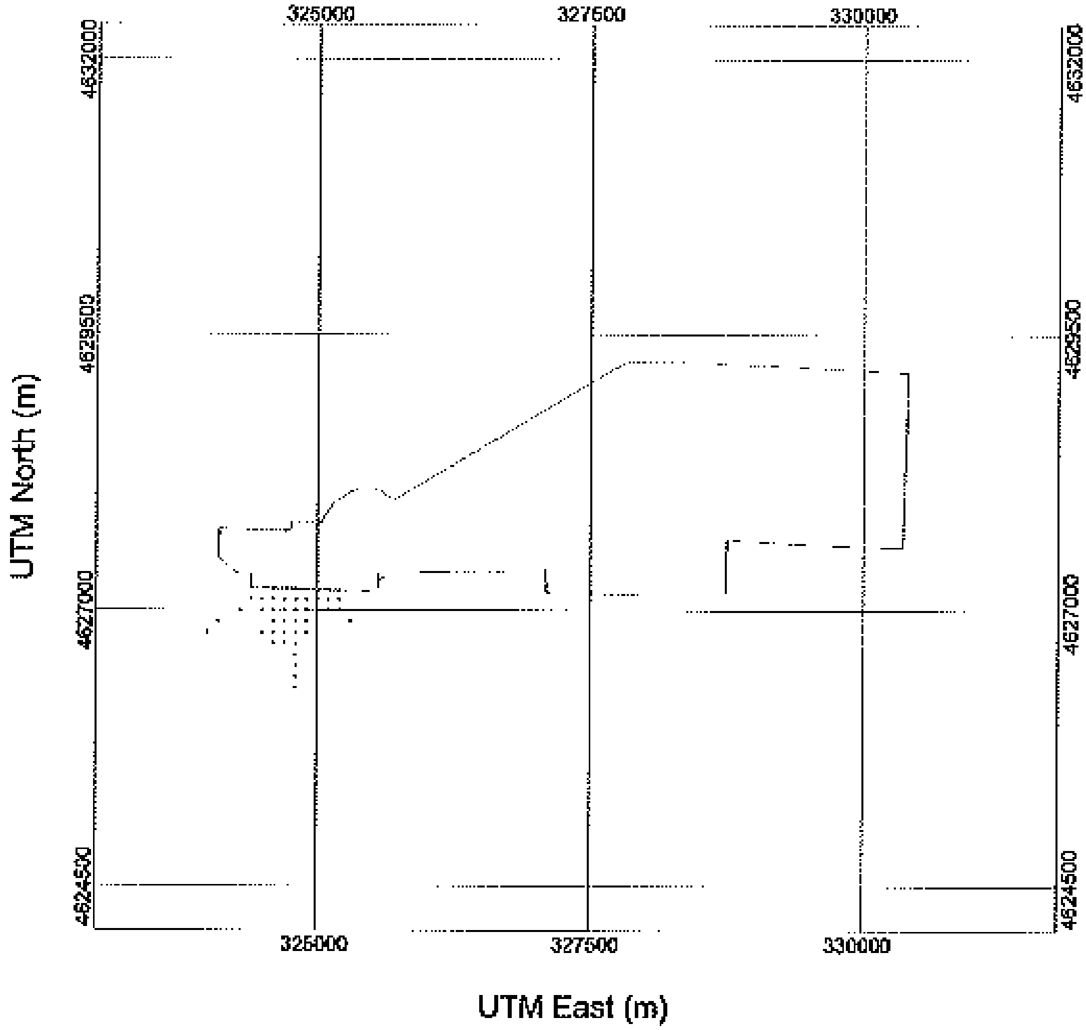


Figure 8-10
Reduced Receptor Grid for Cumulative 1-hr CO



SOLVAY2016_1.2_004697

Figure 8-11
Reduced Receptor Grid for Cumulative 8-hr CO



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SECTION 9
METEOROLOGICAL DATA

The AERMOD modeling analyses discussed in this report used 3 years of onsite meteorological data recently approved by WDEQ-AQD. The following is a summary of the processing prepared by WDEQ-AQD:

Sinclair is conducting meteorological monitoring at the SWRC refinery to collect data suitable for air quality modeling. Monitoring began in September of 2007, and the period of record for the AERMET processing for this project spanned the 3-year period from January 1, 2008 through December 31, 2010. Sinclair conducted the monitoring according to the plan that was submitted to (and approved by) the Division titled *Sinclair Wyoming Refining Company – Meteorological Monitoring Plan* (ENSR Corporation, August 2008). The monitoring station is located at the coordinates shown below:

- 41.785°N, 107.115°W (NAD 83)
- UTM: 324,235 m E; 4,628,059 m N (NAD 83, Zone 13)

The meteorological tower is instrumented at multiple levels:

- Ambient temperature (2 meters, 10 meters, 30 meters)
- Wind speed and direction (10 meters, 30 meters)
- Total solar radiation (2 meters)
- Barometric pressure (2 meters)
- Vertical temperature difference (between 2-10 meters and 2-30 meters)
- Vertical wind speed and vertical wind speed standard deviation (30 meters)

Upper-air data is needed by AERMET to represent the temperature structure aloft. For this project, the nearest upper-air data were available from the National Weather Service (NWS) station in Riverton, Wyoming. The AERMET preprocessor was used to combine the surface data and upper-air data into a format suitable to drive the AERMOD model.

Data from the NWS Automated Surface Observing System (ASOS) station in Rawlins, Wyoming, located approximately five miles west of the Sinclair refinery, were used to substitute for missing data from the refinery. The AERMET processing included the use of 1-minute ASOS wind data from Rawlins. These 1-minute files are used to reduce the number of calm/missing hours that result from the use of the standard surface files that utilize a single observation to represent a given hour. AERMET and the AERMINUTE processor (both version 11059), which are capable of averaging the 1-minute ASOS data for each hour, were used to produce the datasets described here.

Stage 3 of AERMET processing (also called the METPREP stage) requires the input of surface characteristics of the areas from which the surface meteorological data were collected. These surface characteristics, which are used by AERMET to determine heat fluxes and atmospheric stability, include:

- midday albedo – fraction of solar radiation reflected at the surface

- daytime Bowen ratio – indicator of surface moisture
- surface roughness length – height of obstacles to the wind flow

Seasonal values of surface roughness, Bowen ratio and midday albedo were determined using the EPA AERSURFACE program (08009). This program, which was released in January of 2008, makes use of electronic land cover data from the U.S. Geological Survey to automatically calculate surface characteristics for a given modeling domain.

An AERSURFACE user has the option of choosing Bowen ratios that are tailored for dry, average, or wet conditions. Based on available precipitation data from the Rawlins area, the Division chose "average" moisture conditions for each of the three years of data that were processed. Given that the long-term average annual precipitation total at Rawlins is approximately 9.0 inches per year, the area was classified as "arid" for AERSURFACE processing. Seasonal classifications for the twelve months of the year followed the standard AERMET/AERSURFACE breakdown (e.g. spring = March, April, and May only).

For final calculation of heat fluxes and stability in Stage 3 of AERMET, the Division chose the Bulk Richardson method. This method prompts AERMET to make use of the temperature difference measurements that were collected at the refinery. Wind roses for the 10-meter and 30-meter levels are presented in Figures 1 and 2.

Figure 1: 10-Meter Wind Rose

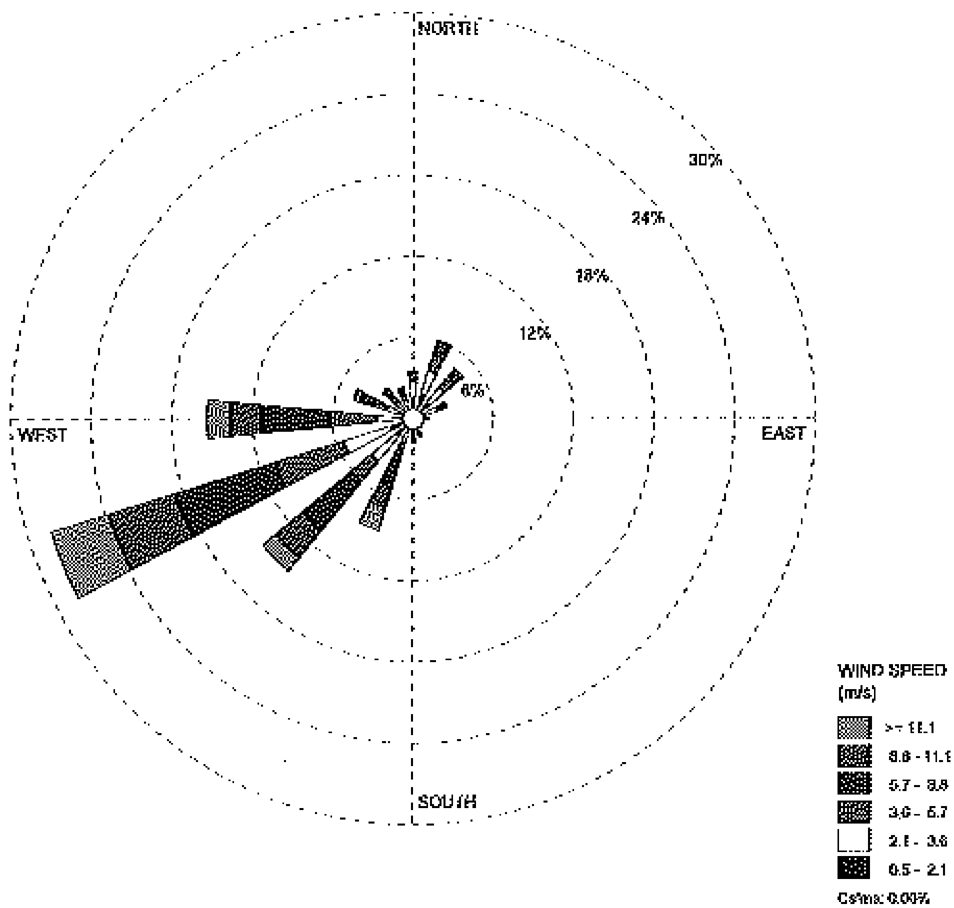
WIND ROSE PLOT:

Station #72574

DISPLAY:

Wind Speed

Direction (blowing from)



COMMENTS:

DATA PERIOD:

2008

Jan 1 - Dec 31

00:00 - 23:00

COMPANY NAME:

MODELER:

CALM WINDS:

0.00%

TOTAL COUNT:

8784 hrs.

AVG. WIND SPEED:

5.91 m/s

DATE:

7/29/2011

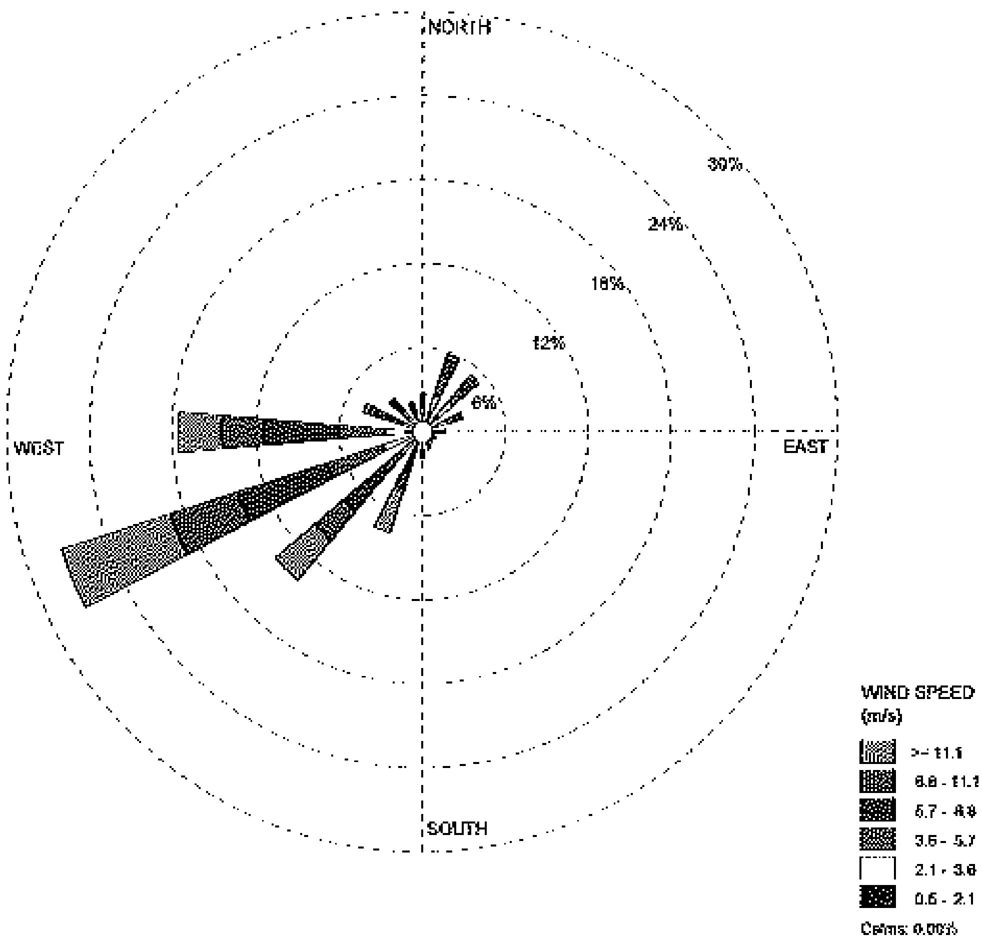
PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Figure 2: 30-Meter Wind Rose

WIND ROSE PLOT:
Station #0 - Sinclair Refinery: 30-m Winds

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	2008 **Jan 1 - Dec 31** **00:00 - 23:00**	MODELER:	
	CALM WINDS: **0.00%**	TOTAL COUNT: **8757 hrs.**	
	AVG. WIND SPEED: **7.13 m/s**	DATE: **6/8/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

SOLVAY2016_1.2_004702

SECTION 10
MODEL REFINEMENTS AND POST-PROCESSING

While the new 1-hour NAAQS is defined relative to ambient concentrations of NO_2, the majority of nitrogen oxides (NO_x) emissions for stationary and mobile sources are in the form of nitric oxide (NO) rather than NO_2. In addition, the new standard for NO_2 is attained when the 3-year average of the 98th-percentile of the annual distribution of daily maximum 1-hour concentrations does not exceed the threshold value of 100 parts-per-billion. As a result, special techniques discussed below were used to demonstrate compliance of SWRC operations with the new standards.

10.1 NO_2 Modeling Options

The U.S. EPA's NO_2 modeling memorandum[14] and clarification[15] provide four main options for 1-hour averaging period modeling for NO_2:

- Tier 1 – Regulatory default modeling assuming full conversion of NO to NO_2;
- Tier 2 (Ambient Ratio Method, aka ARM) – Regulatory default modeling with Tier 1 results multiplied by empirically-derived NO_2/NO_x annual national default ratio of 0.75. The March 1, 2011 EPA memorandum authorized using the 1-hour NO_2/NO_x default ratio of 0.8.
- Tier 3A (Ozone Limiting Method, aka OLM) – non regulatory default beta option;
- Tier 3B (Plume Volumetric Molar Ratio Method, aka RVMRM) – non regulatory default beta option.

Tier 2 option was used in the 1-hour and annual NO_2 modeling. Note that the chemical name used for NO_x in the cumulative modeling analyses was "NO2". This name convention was selected because this is the chemical ID used by the new AERMOD software (ver. 11103) to complete special treatment of the model predictions (e.g., averaging periods). However, the modeled emission rates were for NO_x; therefore, the Tier 2 adjustments were applied to the model-calculated values.

[14] U.S. EPA, *Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS*, Memorandum, Office of Air Quality Planning and Standards, June 28, 2010.
[15] U.S. EPA, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS*, Memorandum, EPA's New Source Review Policy & Guidance Web page, March 1, 2011.

SECTION 11
MODELING RESULTS AND SUBMITTALS

The modeling results for each pollutant and averaging period are summarized in the following subsections of this section. Tables comparing the design concentrations for each averaging period for each pollutant to the applicable significance level, PSD Increment, and NAAQS are included in this section or in Appendices B through F, as referenced. Also included in Appendix D are figures showing the location of the Cumulative NAAQS/WAAQS results.

A digital video disk (DVD) accompanying this report contains all model input and output files, as well as meteorological data electronic files pertinent to the modeling analyses, terrain files, downwash files, and supporting information files.

11.1 Modeling Results for NO_2

A Significant Impact Analysis was performed for 1-hour and annual NO_2 as discussed in Section 1.4. Three years of onsite meteorological data were used, as was the full base receptor grid. Maximum modeled concentrations over the three year period (assuming full conversion of NO_x to NO_2) were compared for each receptor to the SILs. One receptor for the annual averaging period and 94 receptors for the 1-hour averaging period were found to exceed the Class II SILs. These receptors were then included in the NAAQS/WAAQS cumulative analysis. Figures depicting these reduced receptor grids can be found in Section 8.

A Cumulative Modeling Analysis was performed using the reduced receptor grids, the three years of meteorological data, and an emissions inventory including all onsite and surrounding offsite sources modeled at their maximum PTEs.

The highest-eight highest maximum daily value averaged over the three years, adjusted using the ARM (0.8) plus background 1-hour ambient air concentration for NO_2 is 132.5 $\mu g/m^3$, or approximately 70% of the NAAQS (188 $\mu g/m^3$). Since no PSD Increment standard has been established for this averaging period, the demonstration is complete.

The highest adjusted (ARM) plus background annual ambient air concentration for NO_2 (Year 2009) is 15.7 $\mu g/m^3$, or approximately 16% of the NAAQS (100 $\mu g/m^3$). The highest adjusted predicted concentration without background is 10.0 $\mu g/m^3$, or approximately 40% of the PSD Increment standard (25 $\mu g/m^3$). Since all sources were modeled with the Potential-to-Emit rates, no additional demonstration is required to document that the PSD Increment will not be violated.

Full NO_2 modeling results can be found in the tables in Appendix D.

11.2 Modeling Results for SO_2

A Significant Impact Analysis was performed for 1-hour, 3-hour, 24-hour and annual SO_2 as discussed in Section 1.4. Three years of onsite meteorological data were used, as was the full base receptor grid. Maximum modeled concentrations over the three year period were compared for each receptor to the SILs.

No receptors exceeded the SIL for the annual average. Therefore, no cumulative NAQQS/WAAQS or Increment analyses were required.

41 receptors for the 24-hour averaging period, 28 receptors for the 3-hour averaging period and 917 receptors for the 1-hour averaging period were found to exceed the Class II SILs. These receptors were then included in the NAAQS/WAAQS cumulative analysis. Figures depicting these reduced receptor grids can be found in Section 8.

A Cumulative Modeling Analysis was performed using the reduced receptor grids, the three years of meteorological data, and an emissions inventory including all onsite and surrounding offsite sources modeled at their maximum PTEs.

The highest-fourth highest maximum daily value averaged over three years plus background 1-hour ambient air concentration for SO_2 is 102.0 $\mu g/m^3$, or approximately 52% of the NAAQS (195 $\mu g/m^3$). Since no PSD Increment standard has been established for this averaging period, the demonstration is complete.

The highest-second highest plus background 3-hour ambient air concentration for SO_2 (Year 2009) is 97.1 $\mu g/m^3$, or approximately 7.5% of the NAAQS (1300 $\mu g/m^3$). The highest-second highest predicted concentration without background is 81.5 $\mu g/m^3$, or approximately 16% of the PSD Increment standard (512 $\mu g/m^3$). Since all sources were modeled with the Potential-to-Emit rates, no additional demonstration is required to document that the PSD Increment will not be violated.

The highest-second highest plus background 24-hour ambient air concentration for SO_2 (Year 2010) is 62.3 $\mu g/m^3$, or approximately 24% of the WAAQS (260 $\mu g/m^3$). The highest-second highest predicted concentration without background is 57.1 $\mu g/m^3$, or approximately 63% of the PSD Increment standard (91 $\mu g/m^3$). Since all sources were modeled with the Potential-to-Emit rates, no additional demonstration is required to document that the PSD Increment will not be violated.

Full SO_2 modeling results can be found in the tables in Appendix D.

11.3 Modeling Results for CO

A Significant Impact Analysis was performed for 1-hour and 8-hour CO as discussed in Section 1.4. Three years of onsite meteorological data were used, as was the full base receptor grid. Maximum modeled concentrations over the three year period were compared for each receptor to the SILs.

120 receptors for the 1-hour averaging period and 66 receptors for the 8-hour averaging period were found to exceed the Class II SILs. These receptors were then included in the NAAQS/WAAQS cumulative analysis. Figures depicting these reduced receptor grids can be found in Section 8.

A Cumulative Modeling Analysis was performed using the reduced receptor grids, the three years of meteorological data, and an emissions inventory including all onsite and surrounding offsite sources modeled at their maximum PTEs.

The highest-second highest 1-hour ambient air concentration for CO (Year 2010) is 12,517 μg/m^3, or approximately 31% of the NAAQS (40,000 μg/m^3). No background concentration was provided for 1-hour CO. Given the relatively low (31% of the standard) maximum modeled concentration, it is extremely unlikely that adding a background value to this concentration it would approach the NAAQS. Additionally, there are no Increment standards in place for CO. Therefore, this analysis was deemed complete.

The highest-second highest 8-hour ambient air concentration for CO (Year 2009) is 4,800 μg/m^3, or approximately 48% of the NAAQS (10,000 μg/m^3). No background concentration was provided for 8-hour CO. Given the relatively low (48% of the standard) maximum modeled concentration, it is extremely unlikely that adding a background value to this concentration it would approach the NAAQS. Additionally, there are no Increment standards in place for CO. Therefore, this analysis was deemed complete.

Full CO modeling results can be found in the tables in Appendix D.

11.4 Modeling Results for PM_{10}

A Significant Impact Analysis was performed for 24-hour and annual PM_{10} as discussed in Section 1.4. Three years of onsite meteorological data were used, as was the full base receptor grid. Maximum modeled concentrations over the three year period were compared for each receptor to the SILs.

No receptors exceeded the SIL for the 24-hour or annual averaging periods. Therefore, no cumulative NAQQS/WAAQS or Increment analyses were required.

Full PM_{10} modeling results can be found in the tables in Appendix D.

11.5 Modeling Results for $PM_{2.5}$

A Significant Impact Analysis was performed for 24-hour and annual $PM_{2.5}$ as discussed in Section 1.4. Three years of onsite meteorological data were used, as was the full base receptor grid. Maximum modeled concentrations over the three year period were compared for each receptor to the SILs.

No receptors exceeded the SIL for the annual average. Therefore, no cumulative NAQQS/WAAQS or Increment analyses were required.

Two receptors for the 24-hour averaging period were found to exceed the Class II SIL. These receptors were then included in the NAAQS/WAAQS cumulative analysis. Figures depicting this reduced receptor grid can be found in Section 8.

A Cumulative Modeling Analysis was performed using the reduced receptor grid, the three years of meteorological data, and an emissions inventory including all onsite and surrounding offsite sources modeled at their maximum PTEs.

The maximum modeled plus background 24-hour ambient air concentration for $PM_{2.5}$ (Year 2009) is 15.00 μg/m^3, or approximately 43% of the NAAQS (35 μg/m^3). The maximum modeled concentration without background is 6.00 μg/m^3, or approximately 67% of the PSD

Increment standard (9.0 μg/m^3). Since all sources were modeled with the Potential-to-Emit rates, no additional demonstration would be required to document that the PSD Increment will not be violated. $PM_{2.5}$ increments do not become effective until October 20, 2011. Therefore, this analysis is not applicable.

Full $PM_{2.5}$ modeling results can be found in the tables in Appendix D.

11.6 Modeling Results for Class I Area SID

For the Class I Area Significant Impact modeling, emissions were modeled from all project related sources as well as emissions increases and decreases over the contemporaneous period. Maximum AERMOD predictions at a distance of 50 km from the modeled sources in all directions were compared to the Class I Area SILs.

The highest annual NO_X (unadjusted) concentration at the distance of 50 km from the project sources is 0.00 μg/m^3, or 0% of the Class I SIL (0.1 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest annual SO_2 concentration at the distance of 50 km from the project sources is 0.00 μg/m^3, or 0% of the Class I SIL (0.1 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest 24-hour SO_2 concentration at the distance of 50 km from the project sources is 0.003 μg/m^3, or 1.4% of the Class I SIL (0.2 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest 3-hour SO_2 concentration at the distance of 50 km from the project sources is 0.043 μg/m^3, or 4.3% of the Class I SIL (1.0 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest predicted 24-hour PM_{10} concentration at the distance of 50 km from the project sources is 0.00 μg/m^3, or 0% of the Class I SIL (0.3 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest predicted annual PM_{10} concentration at the distance of 50 km from the project sources is 0.00 μg/m^3, or 0% of the Class I SIL (0.2 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, the modeling indicated that the project will not create any threat to the PSD Increment standard at the Class I areas.

The highest predicted 24-hour $PM_{2.5}$ concentration at the distance of 50 km from the project sources is 0.00 μg/m^3, or 0% the Class I SIL (0.07 μg/m^3). Since the concentration at 50 km from the project sources is less than the SIL, no further demonstration is required. Note that the Class I Increments for PM2.5 do not come into effect until October 20, 2011.

The highest predicted Annual $PM_{2.5}$ concentration at the distance of 50 km from the project sources is 0.00 $\mu g/m^3$, or 0% the Class I SIL (0.06 $\mu g/m^3$). Since the concentration at 50 km from the project sources is less than the SIL, no further demonstration is required. Note that the Class I Increments for PM2.5 do not come into effect until October 20, 2011.

Full Class I modeling results can be found in the tables in Appendix F.

11.7 WDEQ-AQD Inhalation Risk Assessment

An inhalation risk assessment for Hazardous Air Pollutants (HAP) from project related sources was performed. Per WDEQ-AQD guidance, a Tier 1 (screening level) analysis was performed to estimate the chronic carcinogenic risks for the project. The analysis followed the facility-specific assessment guidance developed by EPA as described in the document *Air Toxics Risk Assessment Reference Library, Volume 2, Facility Assessment*. The analysis used the AERMOD model and base receptor grid per additional WDEQ-AQD guidance.

The AERMOD dispersion model was used along with the three years of onsite meteorological data to determine the highest predicted ambient air concentration per unit of mass emission rate for the annual averaging period (X/Q). This analysis applied the same downwash parameters and receptor grid as the Significant Impact analyses described above.

Table E-2 presents the model results (X/Q) for each HAP source. The X/Q value was multiplied by the emission rate for each HAP in Table E-1 to determine a maximum predicted ambient air concentration as shown in Table E-3.

Carcinogenic risks were assessed using the dispersion modeling described above and numerical values of toxicity provided in Table E-4. This method only assesses risks associated with the inhalation pathway. Cancer risk was assessed for each pollutant by dividing the maximum predicted annual ambient air concentration by the unit risk factor. This quotient is then multiplied by one million to yield the maximum predicted increase in cancer risk per million within the receptor grid. The indices for each pollutant and source were summed to determine the overall cancer risk.

Table E-5 presents the cancer risk assessment results. The calculated cancer risk was 1.0 per million. This predicted risk is equal to the established health risk assessment significance threshold. However, given the conservative nature of this analysis (that an individual would be exposed to the maximum concentrations continuously for 70 years) we believe this number shows insignificance and compliance with this requirement.

Individual risks for each pollutant and source are presented in Table E-5.

SECTION 12
ADDITIONAL IMPACTS ANALYSES

PSD rules require special analyses related to protection of the environment.

12.1 Visibility, Soils, and Vegetation

Additional impact analyses are required for PSD permit applications. The three types of additional impacts analyses are growth, soils and vegetation, and visibility.

12.1.1 Growth Analysis

Per the U.S. EPA Guidelines[16], a growth analysis is required only "if the project would result in a significant shift of population and associated activity into an area - that is, a population increase on the order of thousands of people." Temporary increase in the local population may occur only during the construction period of this project; however, the project will not result in a significant population shift or increase. The number of net new jobs in the community will not result in a significant shift of population. Therefore, a growth analysis is not required.

12.1.2 Soils and Vegetation Analysis

A search was conducted for information regarding soils and vegetation in the vicinity of SWRC. The most recent analysis was done by the Bureau of Land Management (BLM) in support of the Chokecherry and Sierra Madre Draft EIS (BLM, 2011)[17]. The Chokecherry project area is located approximately 2 miles directly south of SWRC. Excerpts from this document are provided below:

"The most commonly encountered soils in the Chokecherry area include the Rentsac, Blazon, and Diamondville series. The Rentsac series occurs on mountains, escarpments, bedrock-floored plains, and hills. Slopes range from 10 to 70 percent. Rentsac soils are shallow to calcareous sandstone with loamy-skeletal textures. Water erosion potential is high and wind erosion potential is moderate. Topsoil suitability is poor due to large stones. The Blazon series is shallow to shale bedrock and occurs on pediments, hillslopes, plateaus and ridges. Slopes range from 6 to 40 percent. The Blazon series is calcareous and is also compaction prone when moist or saturated. Water erosion potential is high and wind erosion potential is moderate. Topsoil suitability is good. The Diamondville series consists of moderately deep, well drained soils that formed in alluvium and residuum weathered from calcareous loamstone and sandstone. Diamondville soils are on fan remnants, plateaus, hills and ridges of cold intermountain basins. Slopes range from 3 to 70 percent. Water erosion potential is severe and wind erosion potential is slight. Topsoil suitability is fair due to high clay."

"A majority of the Chokecherry portion of the Application Area is mapped as rolling sagebrush steppe. The rolling sagebrush steppe is a semiarid region of unglaciated plains and hills, featuring

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[16] U.S. EPA, *Draft New Source Review Workshop Manual. Prevention of Significant Deterioration and Nonattainment Area Permitting*, U.S. EPA, Office of Air Quality, October 1990. *Chapter D, Additional Impact Analyses.*

[17] BLM, *Chokecherry and Sierra Madre Wind Energy Project DEIS*, BLM, accessed online: http://www.blm.gov/wy/st/en/info/NEPA/documents/rfo/Chokecherry.html, September, 2011. *Chapter 3, Affected Environment.*

primarily ephemeral drainages. The potential natural vegetation in this ecoregion is listed as western wheatgrass (*Elymus smithii*), needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koeleria macrantha*), various species of rabbitbrush (*Chrysothamnus* sp. and *Ericameria nauseosa*), fringed sage (*Artemisia frigida*), Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), silver sagebrush (*Artemisia cana*) and black sagebrush (*Artemisia nova*) in lowlands, and mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*) in higher elevation uplands (Chapman et al. 2004)."

None of the above listed soils or vegetation are identified as being sensitive. Presented below is Table 12-1, containing vegetation exposure screening thresholds.

Table 12-1
Vegetation Exposure Screening Thresholds

Pollutant	Averaging Period	Sensitive Vegetation Threshold Value (µg/m3)	Intermediate Vegetation Threshold Value (µg/m3)	Resistant Vegetation Threshold Value (µg/m3)
SO_2	1-hour	917	---	---
	3-hour	786	2,096	13,100
	Annual	18	18	18
NO_2	4-hours	3,760	9,400	16,920
	8-hours	3,760	7,520	15,040
	1 month	564	564	564
	Annual	94-188	94-188	94-188
CO	1 week	$1.8x10^5$	---	$1.8x10^5$

Source: *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078), dated 12/12/1980.

Based on the results of the NAAQS/WAAQS modeling presented in Section 11, none of the Vegetation Exposure Screening Thresholds will be exceeded by the project. Therefore, there should be no detrimental effect to soils or vegetation in the area.

12.2 Class I Area AQRVs

A Class I PSD Area is defined as either:

- International park
- National wilderness area greater than 5,000 acres
- National memorial park greater than 5,000 acres
- National park greater than 6,000 acres

The nearest Class I area to SWRC is the Savage Run Wilderness Area, which is approximately 75 kilometers from the location of the project sources.

Per the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) guidance, Class I visibility and Air Quality Related Values (AQRV) analyses must be conducted if the sum of the PM_{10}, SO_2, and NO_X emission increases from the project, in tons per year (tpy) exceeds 10D, where D is the distance in kilometers from the source. A full Q/D analysis and request for determination of need for an analysis has been submitted by SWRC to WDEQ-AQD and was forwarded on to the appropriate Federal Land Managers (FLMs). It was determined, by all affected agencies, that no Class I AQRV impact will be required for this project.

APPENDIX A
BPIP STRUCTURE INFORMATION

The following attachments are included in this appendix in the following order:

- Table A-1: Location and Parameters of Rectangular and Polygonal Structures
- Table A-2: Location and Parameters of Circular Structures

Table A-1

Sinclair Wyoming Refining Company

Location and Parameters of Rectangular and Polygonal Structures

Structure Name	No. of Tiers	Tier No.	Tier Height (m)	Tier Height (ft)	Base Elevation (m)	Base Elevation (ft)	No. of Corners	Corner 1 East (X) (m)	Corner 1 North (Y) (m)	Corner 2 East (X) (m)	Corner 2 North (Y) (m)	Corner 3 East (X) (m)	Corner 3 North (Y) (m)	Corner 4 East (X) (m)	Corner 4 North (Y) (m)	Corner 5 East (X) (m)	Corner 5 North (Y) (m)	Corner 6 East (X) (m)	Corner 6 North (Y) (m)	Corner 7 East (X) (m)	Corner 7 North (Y) (m)	Corner 8 East (X) (m)	Corner 8 North (Y) (m)
BLDG4	1	1	3.96	13	2009.3	6592.1	4	324,552	4,627,248	324,552	4,627,255	324,595	4,627,255	324,595	4,627,248								
BLDG5	1	1	7.92	26	2008.9	6590.8	4	324,614	4,627,289	324,614	4,627,216	324,645	4,627,216	324,645	4,627,289								
BLDG6	1	1	7.92	26	2009.1	6591.5	4	324,625	4,627,250	324,625	4,627,257	324,698	4,627,257	324,698	4,627,250								
BLDG7	1	1	7.92	26	2008.8	6590.4	4	324,663	4,627,238	324,663	4,627,252	324,693	4,627,252	324,693	4,627,238								
BLDG8	1	1	9.14	30	2009.1	6591.5	4	324,670	4,627,267	324,670	4,627,289	324,693	4,627,289	324,693	4,627,267								
BLDG9	1	1	7.32	24	2009.0	6591.2	4	324,710	4,627,365	324,710	4,627,387	324,737	4,627,387	324,737	4,627,365								
BLDG10	1	1	10.97	36	2008.5	6589.4	8	324,786	4,627,214	324,786	4,627,235	324,799	4,627,235	324,799	4,627,220	324,777	4,627,229	324,777	4,627,251	324,760	4,627,251	324,760	4,627,213
BLDG11	1	1	9.14	30	2009.4	6592.5	4	324,716	4,627,512	324,716	4,627,552	324,735	4,627,552	324,735	4,627,512								
BLDG12	1	1	7.32	24	2009.6	6593.3	4	324,748	4,627,567	324,748	4,627,609	324,750	4,627,609	324,750	4,627,567								
BLDG13	1	1	4.88	16	2009.4	6592.4	4	324,763	4,627,338	324,763	4,627,333	324,793	4,627,333	324,793	4,627,338								
BLDG14	1	1	3.66	12	2008.7	6590.2	4	324,936	4,627,282	324,936	4,627,314	324,943	4,627,314	324,943	4,627,282								
BLDG15	1	1	7.32	24	2009.0	6591.8	4	324,932	4,627,330	324,931	4,627,346	324,949	4,627,346	324,949	4,627,330								
BLDG16	1	1	10.97	36	2009.1	6591.6	4	324,937	4,627,355	324,937	4,627,371	324,949	4,627,371	324,949	4,627,355								
BLDG17	1	1	8.20	27	2009.2	6591.9	4	324,957	4,627,385	324,957	4,627,393	324,987	4,627,393	324,987	4,627,385								
BLDG18	1	1	9.14	30	2009.1	6591.5	8	325,013	4,627,400	325,013	4,627,396	324,995	4,627,391	324,995	4,627,384	325,012	4,627,384	325,012	4,627,380	325,024	4,627,380	325,024	4,627,400
BLDG19	1	1	3.66	12	2008.5	6589.7	4	324,953	4,627,278	324,953	4,627,281	324,993	4,627,281	324,993	4,627,274								
BLDG20	1	1	9.14	30	2008.3	6588.8	4	324,945	4,627,231	324,945	4,627,249	324,970	4,627,249	324,970	4,627,231								
BLDG21	1	1	9.14	30	2008.6	6587.8	4	325,096	4,627,244	325,095	4,627,265	325,127	4,627,229	325,168	4,627,208								
BLDG22	1	1	9.14	30	2008.0	6588.1	4	325,107	4,627,272	325,107	4,627,317	325,178	4,627,317	325,176	4,627,276								
BLDG23	1	1	9.14	30	2008.1	6588.1	4	325,161	4,627,390	325,161	4,627,391	325,176	4,627,391	325,176	4,627,390								
BLDG24	1	1	9.14	30	2008.2	6588.4	4	325,213	4,627,471	325,213	4,627,489	325,273	4,627,489	325,273	4,627,474								
BLDG25	1	1	3.66	12	2008.0	6588.0	4	325,307	4,627,496	325,307	4,627,506	325,332	4,627,506	325,332	4,627,496								
BLDG26	1	1	3.66	12	2007.9	6587.6	4	325,196	4,627,335	325,196	4,627,341	325,200	4,627,341	325,200	4,627,335								
BLDG34	1	1	31.40	103	2009.0	6595.1	4	324,965	4,627,345	324,965	4,627,355	324,975	4,627,355	324,975	4,627,345								
BLDG38	1	1	9.14	30	2007.9	6587.7	4	325,034	4,627,216	325,034	4,627,219	325,087	4,627,219	325,087	4,627,216								
ELEVTR	1	1	39.32	129	2008.0	6587.8	4	325,368	4,627,286	325,368	4,627,298	325,372	4,627,298	325,372	4,627,286								
FOAM	1	1	10.06	33	2009.2	6593.4	4	324,522	4,627,283	324,522	4,627,299	324,531	4,627,299	324,531	4,627,283								
SAFETY	1	1	10.06	33	2009.4	6592.6	4	324,630	4,627,300	324,661	4,627,300	324,661	4,627,277	324,630	4,627,277								
YCCUBSP	1	1	21.34	70	2008.9	6590.9	8	325,004	4,627,368	325,004	4,627,364	325,013	4,627,364	325,013	4,627,366	325,034	4,627,366	325,034	4,627,369	324,987	4,627,369	324,987	4,627,361

Table A-2
Sinclair Wyoming Refining Company
Location and Parameters of Circular Structures

Tank Name	Base Elevation		UTM Coordinates		Tank Hight		Tank Diameter	
	(m)	(ft)	East (m)	North (m)	(m)	(ft)	(m)	(ft)
TK500	2011.46	6599.28	324719.85	4627633.11	3.05	10.01	34.79	114.14
TK513	2011.37	6598.98	324822.64	4627640.58	12.20	40.03	34.77	114.06
TK312	2010.99	6597.74	324895.14	4627627.75	12.20	40.03	18.44	60.50
TK406	2010.91	6597.47	324717.77	4627560.73	14.30	46.92	37.21	122.09
TK505	2010.37	6595.70	324984.53	4627635.32	9.14	29.99	34.42	112.93
TK401	2009.88	6594.09	324981.03	4627521.91	9.14	29.99	34.83	114.28
TK403	2009.24	6591.99	325082.58	4627520.03	12.20	40.03	25.76	84.53
TK311	2010.62	6596.52	324894.10	4627573.45	12.20	40.03	17.85	58.56
TK304	2010.53	6596.23	324653.86	4627483.66	9.10	29.86	24.14	79.21
TK668	2009.79	6593.80	324892.92	4627445.01	17.20	56.43	20.79	68.22
TK502	2009.63	6593.27	324979.32	4627473.95	9.14	29.99	34.82	114.25
TK541	2009.38	6592.45	325007.05	4627450.10	10.90	35.76	20.81	68.27
TK652	2009.13	6591.63	325036.25	4627430.58	12.20	40.03	9.13	29.95
TK503	2008.69	6590.19	325142.04	4627469.04	9.10	29.86	34.80	114.18
TK512	2008.66	6590.09	325085.39	4627384.15	12.75	41.83	35.26	115.68
TK511	2008.34	6589.04	325083.19	4627312.37	12.50	41.01	35.36	116.02
TK205	2008.76	6590.42	325029.77	4627350.49	9.10	29.86	15.09	49.50
TK4	2008.67	6590.12	325029.81	4627333.61	3.00	9.84	9.06	29.72
TK120	2008.60	6589.90	325029.81	4627321.63	9.75	31.99	7.81	25.62
TK672	2008.13	6588.35	325323.70	4627532.07	11.50	37.73	11.65	38.23
TK671	2008.07	6588.16	325345.12	4627536.35	16.50	54.13	16.51	54.16
TK676	2008.01	6587.96	325369.65	4627553.09	13.00	42.65	12.14	39.83
TK675	2007.96	6587.80	325369.26	4627530.90	13.00	42.65	12.62	41.42
TK674	2008.19	6588.55	325345.12	4627601.36	19.81	64.99	20.06	65.82
TK499	2008.48	6589.50	325282.43	4627625.88	12.19	39.99	37.87	124.25
TK40	2008.59	6589.86	324811.55	4627236.33	9.40	30.84	5.29	17.37
583VT	2008.34	6589.04	324888.35	4627222.68	27.40	89.90	4.86	15.94
BLDG27	2008.22	6588.65	324950.09	4627225.15	15.20	49.87	5.90	19.34
BLDG28	2008.19	6588.55	324943.16	4627217.29	15.20	49.87	5.55	18.21
TK114	2008.10	6588.25	325017.13	4627233.67	9.10	29.86	9.16	30.06
TK113	2008.07	6588.16	325028.17	4627233.67	9.10	29.86	9.20	30.17
BLDG51	2009.29	6592.16	324895.27	4627364.64	12.20	40.03	16.04	52.61
SWS	2008.30	6588.91	325325.13	4627658.19	30.48	100.00	2.25	7.38
CLAR1	2007.70	6586.94	325442.54	4627775.02	12.20	40.03	17.99	59.02
CLAR2	2007.64	6586.75	325457.45	4627758.58	12.20	40.03	19.46	63.83
HBIN	2007.59	6586.58	325474.92	4627737.68	30.10	98.75	12.03	39.45
COKDR1	2007.95	6587.76	325379.59	4627784.21	36.27	119.00	8.34	27.38
COKBDR2	2007.93	6587.70	325388.44	4627784.24	36.27	119.00	8.34	27.38
COKEFRAC	2007.98	6587.86	325375.77	4627769.72	25.91	85.01	4.66	15.30
CONT3	2008.01	6587.96	325388.40	4627659.62	30.48	100.00	2.41	7.89
CONT4	2008.11	6588.29	325362.94	4627716.21	30.48	100.00	2.41	7.89

APPENDIX B
SIGNIFICANT IMPACT ANALYSIS MODEL INPUTS

The following attachments are included in this appendix in the following order:

- Table B-1: SIA – NO_2 Emitting Sources
- Table B-2: SIA – SO_2 Emitting Sources
- Table B-3: SIA – PM_{10} Emitting Sources
- Table B-4: SIA – $PM_{2.5}$ Emitting Sources
- Table B-5: SIA – CO Emitting Sources

Table B-1
SEA – NO_x Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord (meters)	Y Coord (meters)	Elevation (feet)	Elevation (meters)	Stack Height (feet)	Stack Height (meters)	Temperature deg F	Temperature deg K	Exit Velocity (ft/s)	Exit Velocity (m/s)	Stack Diameter (feet)	Stack Diameter (meters)	NOx Maximum Short Term Emission Rate (lb/hr)	NOx Maximum Short Term Emission Rate (g/s)	NOx Annual Emission Rate (TPY)
[illegible]	Hydrocracker Heater HF	324,817	4,627,471	6596.8	2010.6	110.0	33.5	850.0	727.6	29.1	8.96	5.3	1.6200	-8.10	-1.0206	-35.18
[illegible]	81/62 ...	325,001	4,627,379	6598.8	2008.6	100.0	30.5	163.0	345.9	44.9	13.68	2.5	0.7620	-1.14	-0.1436	-4.99
[illegible]	24 HDS H1 Heater 25H-F101	324,771	4,627,581	6597.7	2011.0	100.0	30.5	620.0	599.8	64.7	19.72	3.1	0.9449	0.00	0.0000	0.20
[illegible]	24 HDS H2 Heater 25H-F102	324,771	4,627,571	6597.5	2010.9	100.0	30.5	640.0	611.1	42.5	12.95	3.6	1.0973	0.04	0.0050	0.28
[illegible]	#11 Boiler	324,855	4,627,225	6589.3	2008.4	50.0	15.2	500.0	533.2	77.8	23.58	5.0	1.5240	1.98	0.2495	7.58
FCCREGEN	FCCU Regenerator Vent	325,081	4,627,365	6592.9	2009.5	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1950	-31.60	-3.9815	-256.80
[illegible]	Naphtha Splitter Heater	324,893	4,627,411	6591.6	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2200	6.28	-0.7913	-27.70
[illegible]	28L #1 EIDS Heater	324,835	4,627,360	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2200	-1.35	-0.1166	-30.08
[illegible]	185 LEF Heater	324,991	4,627,259	6590.0	2008.6	210.0	[illegible]	675.0	630.4	21.9	6.68	3.0	0.9100	-4.50	-0.5972	-20.70
[illegible]	761 #1 Reformer Heater	324,837	4,627,310	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5200	0.00	0.0000	0.00
[illegible]	761 #2 Reformer Heater	324,816	4,627,310	6591.6	2009.1	133.0	40.5	940.0	777.6	29.4	8.96	5.0	1.5200	0.00	0.0000	0.00
[illegible]	761 #3 Reformer Heater	324,824	4,627,310	6591.5	2009.1	63.0	19.2	1000.0	855.4	9.6	2.91	4.0	1.2200	0.00	0.0000	0.00
[illegible]	785 Stabilizer Heater	324,888	4,627,310	6591.3	2009.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2200	0.00	0.0000	0.00
[illegible]	583 Vacuum Heater 583 Unit	324,685	4,627,253	6580.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2200	-8.43	-1.0988	-36.80
[illegible]	582 Pre Flash Heater, F101	324,853	4,627,328	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2200	0.00	0.0000	0.02
[illegible]	582 Pre-Flash Heater, F102	324,840	4,627,328	6591.8	2009.2	120.0	36.6	1300.0	977.5	13.0	3.95	5.0	1.5200	0.00	0.0000	0.01
[illegible]	582 Crude Heater, F103A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5200	0.00	0.0000	-0.01
[illegible]	582 Crude Heater, F103B	324,850	4,627,328	6591.6	2009.2	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5200	0.00	0.0000	0.01
[illegible]	582 Vacuum Heater, F104	324,865	4,627,341	6595.9	2009.2	120.0	36.6	770.0	685.2	64.4	19.64	3.0	0.9100	0.00	0.0000	0.02
[illegible]	#2 HDS Heater	324,811	4,627,350	6591.4	2009.1	135.0	41.2	400.0	478.0	17.1	5.21	4.0	1.2200	-5.60	-0.7056	-24.52
[illegible]	#1 HDS Heater	324,795	4,627,471	6590.3	2008.6	78.0	23.8	930.0	780.9	12.9	3.93	4.0	1.2200	-2.20	-0.2772	-9.67
[illegible]	88 High Pressure Boiler	324,770	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	-10.40	-1.3102	-45.66
[illegible]	89 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.95	5.0	1.5200	-10.40	-1.3102	-45.66
[illegible]	Light Oil Loading Rack Flare	325,552	4,627,384	6590.9	2008.8	35.0	10.7	370.0	[illegible]	10.3	3.14	6.0	1.8300	-1.61	-0.1189	-81.57
[illegible]	Hydrocracker Heater H1/H2	324,783	4,627,486	6596.5	2010.5	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0400	-5.40	[illegible]	-6.01
[illegible]	Hydrocracker Heater H3	324,782	4,627,485	6595.7	2010.4	141.0	43.0	630.0	605.4	36.6	11.40	4.3	1.3100	-2.00	-0.2520	-8.71
[illegible]	Hydrogen Plant Heater 88-201	324,800	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	0.02	0.0025	-0.08
[illegible]	Hydrocracker Heater H5	324,857	4,627,473	6594.7	2010.3	135.0	41.2	610.0	594.3	22.0	6.71	4.3	1.3100	[illegible]	0.0113	-4.01
CATOX	Catalytic Oxidation Unit	[illegible]	4,627,393	6592.3	2010.3	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3600	-0.71	-0.0897	-1.34
[illegible]	583 Vacuum Heater - New Unit	324,685	4,627,253	6580.3	2004.4	122.0	37.2	770.0	683.2	31.6	10.46	8.0	1.2192	1.93	0.2432	8.44
COKERHTR	Coker Heater	325,401	4,627,750	6581.7	2007.9	175.0	53.3	615.0	597.0	34.6	10.55	6.8	2.0700	4.80	0.6048	21.02
COKERFLAR	Coker Flare	325,658	4,627,690	6580.0	2006.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.6	2.3213	6.80	0.8568	20.76
[illegible]	John Deere 4045D water fire pump	329,221	4,628,460	6543.7	1994.5	4.6	[illegible]	[illegible]	799.8	131.2	39.99	0.3	0.1000	0.56	0.0706	2.45
[illegible]	88 Heater	324,894	4,627,569	6585.2	2010.2	100.0	30.5	[illegible]	[illegible]	16.9	5.15	5.6	1.7100	1.50	0.1890	6.57
CATOX	New CatOx	324,927	4,627,393	6598.3	2011.2	15.0	4.6	690.0	[illegible]	10.0	3.05	1.2	0.3600	0.12	0.0151	0.53
ALKYH15	Alky Heater H15	325,374	4,627,300	6587.4	2007.8	50.0	15.2	762.0	693.2	1.4	[illegible]	4.6	1.4013	-3.60	-0.4536	-15.80
ALKYH16	Alky Heater H16	325,374	4,627,464	6586.8	2007.9	50.0	15.2	752.0	673.2	3.6	1.10	4.6	1.4021	0.00	0.0000	0.00
[illegible]	Alky Heater H18	325,138	4,627,540	6591.8	2009.0	78.1	23.9	825.0	713.7	3.5	1.05	3.3	1.0058	[illegible]	0.1418	-18.09
[illegible]	410 High Pressure Boiler	324,811	4,627,218	6583.2	2006.6	50.0	15.2	350.0	449.8	36.1	[illegible]	5.0	1.5240	-23.00	-2.8980	-100.70
LPB	Low Pressure Boilers	324,746	4,627,319	6581.9	2005.6	667.0	[illegible]	500.0	533.2	6.4	1.95	12.0	3.6600	-26.80	-3.3767	-117.30
[illegible]	586 Boiler	324,883	4,627,323	6580.0	2005.6	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5200	2.59	0.3263	11.62
[illegible]	#1 TGTU	325,390	4,627,680	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9144	0.82	0.1033	3.59
[illegible]	#2 TGTU	325,300	4,627,724	6588.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	0.82	0.1033	3.59
[illegible]	#2 Hydrogen Plant Heater 88-102	[illegible]	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	[illegible]	0.1260	4.50
CUMMINS	Cummins CFP11E-F20 Pump Engine	325,316	4,627,368	6580.6	2007.6	6.0	1.8	[illegible]	[illegible]	[illegible]	[illegible]	0.3	0.1000	[illegible]	[illegible]	15.59
[illegible]	#11 Boiler	324,721	4,627,270	6580.9	[illegible]	50.0	15.2	330.0	440.8	49.2	15.00	5.0	1.5240	5.20	0.6552	22.78
[illegible]	#12 Boiler	324,826	4,627,233	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5240	2.20	0.2772	9.64
[illegible]	#13 Boiler	324,824	4,627,221	6588.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5240	0.87	0.1096	3.81
[illegible]	Yellowhorse Emergency Generator (Q7025A)	[illegible]	[illegible]	6590.9	2008.9	4.6	[illegible]	975.0	797.0	43.0	[illegible]	0.3	0.1000	0.00	[illegible]	0.88
[illegible]	Asphalt Heater #2	325,045	4,627,911	[illegible]	2008.1	42.0	12.8	1000.0	810.9	14.1	[illegible]	3.0	0.9144	-5.84	[illegible]	[illegible]
[illegible]	Temp Air Comp	324,753	4,627,212	6590.1	2008.7	7.0	2.1	760.0	658.7	328.0	99.97	0.3	[illegible]	0.00	0.0000	-2.55
[illegible]	New Air Compressor	324,753	4,627,212	6590.1	2008.7	7.0	2.1	760.0	658.7	328.0	99.97	0.3	[illegible]	0.00	0.0000	0.66

Table B-4
SIA - SO_2 Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		SO_2 Maximum Hourly Emission Rate		SO_2 Maximum Short Term Emission Rate		SO_2 Annual Emission Rate
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(TPY)
HCUH3	Hydrocracker Heater H3	324,837	4,627,473	6594.8	2010.1	110.0	33.5	830.0	716.3	29.4	8.96	5.3	1.6200	0.00	0.0000	0.00	0.0000	-3.80
FCCTGTU	FCC2 TGTU (Scrubber)	325,091	4,627,728	6588.8	2008.1	160.0	30.5	163.0	345.9	13.9	13.38	2.5	0.7620	-5.24	-0.6602	-5.24	-0.6602	-35.26
HCH1	#4 HDS H2 Heater 25HT101	324,771	4,627,581	6597.7	2011.0	100.0	30.5	630.0	599.8	64.7	19.72	3.1	0.9449	0.00	0.0000	0.00	0.0000	-1.36
HCU2	#4 HDS H2 Heater 25HT102	324,771	4,627,574	6597.5	2010.9	100.0	30.5	690.0	638.4	42.5	12.95	3.6	1.0973	0.00	0.0000	0.00	0.0000	-1.18
#11BOIL	#11 Boiler	324,855	4,627,273	6589.3	2008.4	50.0	15.2	500.0	533.2	72.1	21.98	5.0	1.5240	4.20	0.5292	4.20	0.5292	18.40
FCCREGEN	FCCU Regenerator Vent	325,013	4,627,563	6590.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1900	-121.58	-15.3871	-121.58	-15.3874	-717.22
NAPSPLEE	Naphtha Splitter Heater	324,691	4,627,331	6592.5	2009.1	120.0	36.6	400.0	477.6	20.8	6.37	4.0	1.2200	0.29	0.0365	0.29	0.0365	-1.71
YHDSBLEK	741 #1 HDS Heater	324,811	4,627,350	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2200	0.23	0.0290	0.23	0.0290	-1.69
781LEFH	781 LEF Heater	321,976	4,627,299	6593.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.6	0.9110	-0.01	-0.0013	-0.01	-0.0013	-1.58
#2REF	781 #2 Reformer Heater	324,837	4,627,380	6595.1	2010.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5200	0.00	0.0000	0.00	0.0000	-2.80
#2REF	781 #2 Reformer Heater	324,816	4,627,350	6595.6	2010.1	133.0	40.5	900.0	727.6	29.4	8.95	5.0	1.5200	0.00	0.0000	0.00	0.0000	-1.71
#3REF	781 #3 Reformer Heater	324,824	4,627,380	6595.5	2009.1	63.0	19.2	1060.0	835.4	9.6	2.92	4.0	1.2200	0.00	0.0000	0.00	0.0000	-1.31
STABIL	781 Stabilizer Heater	324,818	4,627,310	6596.3	2009.0	155.0	47.2	685.0	635.9	8.7	2.65	4.0	1.2200	0.00	0.0000	0.00	0.0000	-0.68
581VHOU	581 Vacuum Heater Old Unit	324,685	4,627,233	6589.3	2008.3	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2200	-1.00	-0.1260	-1.00	-0.1260	-4.38
582PFH01	582 Pre-Flash Heater, F101	324,855	4,627,378	6598.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2200	0.00	0.0000	0.00	0.0000	0.00
582PFH03	582 Pre-Flash Heater, F103	321,810	4,627,328	6595.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5200	0.00	0.0000	0.00	0.0000	0.00
582CH02A	582 Crude Heater, F102A	324,847	4,627,328	6592.8	2009.2	120.0	36.6	950.0	772.0	19.5	5.93	5.0	1.5200	0.00	0.0000	0.00	0.0000	0.00
582CH02B	582 Crude Heater, F102B	324,870	4,627,318	6595.6	2009.1	120.0	36.6	1010.0	816.2	11.1	3.39	5.0	1.5200	0.00	0.0000	0.00	0.0000	0.00
582VH104	582 Vacuum Heater, F104	321,865	4,627,341	6598.9	2009.2	120.0	36.6	770.0	683.2	64.1	19.61	3.0	0.9100	0.00	0.0000	0.00	0.0000	0.00
#2HDSHTR	#2 HDS Heater	324,813	4,627,380	6595.4	2009.1	155.0	47.2	400.0	477.6	17.1	5.21	4.0	1.2200	0.00	0.0000	0.00	0.0000	-1.71
#1HDSHTR	#1 HDS Heater	324,765	4,627,374	6593.3	2009.6	78.0	23.8	840.0	720.9	12.2	3.73	4.0	1.2200	0.00	0.0000	0.00	0.0000	-1.13
68HPBOIL	68 High Pressure Boiler	324,770	4,627,234	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	-137.65	-17.3658	-137.65	-17.3658	-292.18
69HPBOIL	69 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	-137.65	-17.3658	-137.65	-17.3658	-292.18
LOLRFLAR	Light Oil Loading Rack Flare	324,332	4,627,361	6593.9	2009.8	35.0	10.7	379.0	465.9	10.3	3.14	6.0	1.8300	0.00	0.0000	0.00	0.0000	0.00
HCUEBEL2	Hydrocracker Heater EB/EF2	324,783	4,627,496	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0400	0.00	0.0000	0.00	0.0000	-2.35
HCH4	Hydrocracker Heater H4	324,782	4,627,495	6595.7	2010.4	144.0	43.9	630.0	605.4	36.4	11.09	3.3	1.0100	0.00	0.0000	0.00	0.0000	-3.82
H2PHTR	Hydrogen Plant Heater H-101	324,600	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	-6.59	-0.8305	-6.59	-0.8303	-28.51
HCH5	Hydrocracker Heater H5	324,837	4,627,473	6594.7	2010.1	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3100	0.26	0.0328	0.26	0.0328	-2.28
CATOX1	Catalytic Oxidation Unit	321,327	4,627,393	6598.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3600	0.00	0.0000	0.00	0.0000	0.00
583VH2	583 Vacuum Heater – New Unit	321,885	4,627,233	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	3.9	1.2192	1.51	0.1903	1.51	0.1903	7.45
COKRHTR	Coker Heater	325,401	4,627,730	6587.7	2007.9	175.0	53.3	615.0	597.0	34.5	10.53	6.8	2.0700	3.40	0.4284	3.40	0.4284	5.54
COKRFLAR	Coker Flare	325,658	4,627,690	6583.0	2006.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.8	2.3763	2.35	0.2961	2.35	0.2961	3.82
FIREPP	Fire Water Pump / wastewater pump	329,233	4,626,463	6513.7	1985.5	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.0900	0.02	0.0025	0.02	0.0025	0.09
0SHHTR	851 Heater	324,594	4,627,509	6595.1	2010.2	100.0	30.5	113.3	318.1	16.9	5.15	5.6	1.7100	0.44	0.0554	0.44	0.0554	1.93
CATOX	New CatOx	324,327	4,627,393	6598.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3600	0.00	0.0000	0.00	0.0000	0.00
ALKYB15	Alky Heater B15	325,371	4,627,550	6587.4	2007.8	50.0	15.2	788.0	693.2	2.1	0.73	3.6	1.0973	-0.40	-0.0504	-0.40	-0.0504	-1.75
ALKYB16	Alky Heater B16	325,371	4,627,561	6586.8	2007.7	50.0	15.2	737.0	665.2	3.6	1.10	3.6	1.1011	0.00	0.0000	0.00	0.0000	0.00
ALKYH1	Alky Heater H1	325,138	4,627,540	6591.1	2009.0	78.4	23.9	825.0	713.7	3.5	1.05	3.3	1.0058	-0.43	-0.0542	-0.43	-0.0542	-1.88
#10BOIL	#10 High Pressure Boiler	321,814	4,627,281	6589.2	2008.4	50.0	15.2	350.0	449.8	33.4	10.79	5.0	1.5240	-2.30	-0.2898	-2.30	-0.2898	-10.00
LPB	Low Pressure Boilers	321,733	4,627,269	6589.9	2008.6	167.0	50.9	505.0	535.2	6.4	1.95	12.0	3.6606	-86.69	-10.9314	-86.69	-10.9314	-384.03
581CH	581 Heater HT104	324,878	4,627,223	6589.0	2008.3	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5200	2.39	0.3013	2.39	0.3011	8.70
#2TGTU	#2 TGTU	325,100	4,627,650	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	12.57	1.5838	12.57	1.5838	33.03
#1TGTU	#1 TGTU	325,060	4,627,724	6584.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	12.57	1.5838	12.57	1.5838	33.03
H2HTR	#2 Hydrogen Plant Heater H-102	324,722	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	1.07	0.1348	1.07	0.1348	4.73
CUMMINS	Cummins CFP11E-F20 Pump Engine	325,116	4,627,368	6586.6	2007.6	6.0	1.8	861.0	733.9	390.0	118.87	0.3	0.1000	0.00	0.0000	0.14	0.0176	0.61
#11BOIL	#11 Boiler	324,775	4,627,270	6590.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5240	3.40	0.4284	3.40	0.4284	3.50
#12BOILER	#12 Boiler	321,826	4,627,273	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5200	5.20	0.6552	5.20	0.6552	8.40
#13BOIL	#13 Boiler	324,814	4,627,281	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5200	2.00	0.2520	2.00	0.2520	8.76
BHGEN	Boilerhouse Emergency Generator (QT075A)	324,714	4,627,355	6590.9	2008.9	4.6	1.4	975.0	797.0	43.0	13.11	0.3	0.1000	0.00	0.0000	0.00	0.0000	0.00
ASPHHK2	Asphalt Heater #2	325,043	4,627,311	6583.3	2008.1	42.0	12.8	1000.0	810.9	14.2	4.32	3.0	0.9144	-1.59	-0.2004	-0.70	-0.0882	-0.31
BHCOMP08	Boilerhouse Emerg Air Comp	324,753	4,627,232	6591.1	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1036	0.00	0.0000	-0.12	-0.0151	-0.04

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Table B-2
SIA - SO_2 Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		SO_2 Maximum Hourly Emission Rate		SO_2 Maximum Short Term Emission Rate		SO_2 Annual Emission Rate
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)	(lb/hr)	(g/s)	(TPY)
NEWCOM	New Air Compressor	321,255	4,627,212	6500.1	1981.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	0.00	0.0050	0.14	0.0176	0.04

[illegible]

[illegible]

Table B-3
SIA - PM_{10} Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord (meters)	Y Coord (meters)	Elevation (feet)	Elevation (meters)	Stack Height (feet)	Stack Height (meters)	Temperature deg F	Temperature deg K	Exit Velocity (ft/s)	Exit Velocity (m/s)	Stack Diameter (feet)	Stack Diameter (meters)	PM_{10} Maximum Short Term Emission Rate (lb/hr)	PM_{10} Maximum Short Term Emission Rate (g/s)	PM_{10} Annual Emission Rate (TPY)
HCLH3	Hydrocracker Heater H3	324,937	4,627,315	6591.8	2020.1	110.0	33.5	890.0	750.3	29.4	8.96	5.3	1.6200	0.00	0.0000	0.00
[illegible]	4062 TO FU (Scrubber)	325,063	4,627,276	6586.2	2008.1	100.0	30.5	163.0	345.9	41.9	12.78	2.5	0.7620	-0.08	-0.0013	-0.05
[illegible]	24 H2 Heater [illegible]	324,775	4,627,551	6593.3	2010.0	100.0	30.5	600.0	589.8	64.7	19.72	3.0	0.9139	0.00	0.0000	0.00
[illegible]	25 H2 Heater [illegible]	326,778	4,627,574	6597.5	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0972	0.00	0.0000	0.00
[illegible]	614 Boiler	324,653	4,627,223	6589.3	2008.4	50.0	15.2	140.0	333.2	72.8	21.99	5.0	1.5240	0.13	0.0126	1.45
FCCREGEN	FCCU Regenerator Vent	325,013	4,627,365	6600.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1900	-59.50	-7.5416	-261.50
NAPSPLH	Naphtha Splitter Heater	324,696	4,627,332	6601.5	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2200	0.03	0.0038	0.11
[illegible]	781 #2 HDS Heater	324,891	4,627,310	6601.5	2009.2	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2200	0.02	0.0025	0.10
[illegible]	781 EEF Heater	324,973	4,627,290	6590.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.0	0.9144	0.00	0.0000	0.00
[illegible]	741 #1 Reformer Heater	324,837	4,627,310	6591.4	2009.1	150.0	45.7	850.0	727.6	23.2	7.38	5.0	1.5200	0.00	0.0000	0.00
[illegible]	741 #2 Reformer Heater	324,816	4,627,310	6591.6	2009.1	133.0	40.5	940.0	777.6	29.4	8.95	5.0	1.5200	0.00	0.0006	0.00
[illegible]	781 #3 Reformer Heater	324,826	4,627,310	6591.5	2009.1	63.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2200	0.00	0.0001	0.00
[illegible]	781 Stabilizer Heater	324,848	4,627,330	6591.1	2009.0	45.0	13.7	681.0	633.9	8.7	2.65	4.0	1.2200	0.00	0.0000	0.00
[illegible]	583 Vacuum Heater [illegible]	321,565	4,627,213	6583.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2200	-0.06	-0.0081	-0.35
[illegible]	582 Pre Flash Heater, F103	324,851	4,627,328	6590.7	2009.1	120.0	36.6	1060.0	844.3	15.0	4.55	4.0	1.2200	0.00	0.0000	0.00
[illegible]	590 Pre-Flash Heater, F503	324,840	4,627,328	6591.6	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5200	0.00	0.0000	0.00
[illegible]	581 Crude Heater, F102A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5200	0.00	0.0000	0.00
[illegible]	582 Crude Heater, F102B	324,870	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	18.3	5.58	5.0	1.5200	0.00	0.0000	0.00
[illegible]	582 Vacuum Heater, F104	324,863	4,627,348	6591.9	2009.2	120.0	36.6	770.0	683.2	64.4	19.64	3.0	0.9144	0.00	0.0000	0.00
[illegible]	#2 HDS Heater	[illegible]	4,627,310	6592.4	2009.3	135.0	41.1	[illegible]	[illegible]	17.6	5.26	4.0	1.2100	0.00	0.0000	0.00
[illegible]	#1 HDS Heater	324,765	4,627,471	6605.3	2009.6	78.0	23.8	910.0	760.9	17.2	5.23	4.0	1.2100	0.00	0.0000	0.00
[illegible]	#3 High Pressure Boiler	324,770	4,627,339	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	-14.88	-1.7866	-65.18
[illegible]	#2 High Pressure Boiler	324,779	4,627,293	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	-14.88	-1.7866	-65.08
[illegible]	Light Oil Loading Rack Flare	324,532	4,627,314	6589.0	2008.3	35.0	10.7	370.0	463.9	10.3	3.14	6.0	1.8300	0.00	0.0000	0.00
[illegible]	Hydrocracker Heater [illegible]	324,787	4,627,466	6595.5	2010.3	120.0	36.6	690.0	[illegible]	30.5	9.30	3.4	1.0400	0.00	0.0000	0.00
[illegible]	Hydrocracker Heater H4	324,782	4,627,495	6595.7	2010.4	[illegible]	[illegible]	690.0	[illegible]	36.4	11.09	4.3	1.3100	0.00	0.0000	0.00
[illegible]	Hydrogen Plant Heater H-101	324,800	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	0.00	0.0000	0.00
[illegible]	Hydrocracker Heater H5	324,857	4,627,473	6594.7	2010.1	45.0	13.7	610.0	594.3	21.9	6.58	4.3	1.3100	0.00	0.0000	0.00
CATOXI	Catalytic Oxidation Unit	324,527	4,627,390	6575.5	2011.2	15.0	4.6	[illegible]	616.5	30.0	[illegible]	1.2	[illegible]	0.00	0.0000	0.00
[illegible]	583 Vacuum Heater - New Unit	324,635	4,627,213	6589.1	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	0.12	0.0151	0.53
COKERHTR	Coker Heater	325,498	4,627,950	6591.7	2007.9	175.0	53.3	615.0	597.0	31.5	10.53	6.8	2.0700	0.27	0.0340	1.18
COKEFLAR	Coker Flare	325,698	4,627,909	6581.0	2006.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.8	2.3723	0.19	0.0230	0.82
[illegible]	John Deere 4045 Diesel [illegible] transfer pump	329,221	4,628,864	6591.7	2009.5	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.0900	0.05	0.0063	0.22
[illegible]	HST Heater	325,691	4,627,509	6585.6	2010.1	100.0	30.5	315.3	[illegible]	16.9	5.15	5.6	1.7100	0.09	0.0113	0.41
CATOX	New CatOx	324,127	4,627,360	6588.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3600	0.00	0.0000	0.01
ALKYH15	Alky Heater H15	325,374	4,627,500	6587.4	2007.8	50.0	15.2	758.0	676.2	2.4	0.73	3.6	1.0973	-0.03	-0.0038	-0.15
ALKYH16	Alky Heater H16	325,374	4,627,464	6586.8	2007.7	50.0	15.2	752.0	673.2	3.6	1.10	3.6	1.0971	0.00	0.0000	0.00
[illegible]	Alky Heater [illegible]	325,139	4,627,590	6591.1	2009.0	78.4	23.9	825.0	713.7	3.5	1.05	3.5	1.0658	-0.06	-0.0080	-0.26
[illegible]	560 High Pressure Boiler	321,816	4,627,211	6580.2	2005.4	90.0	27.4	340.0	[illegible]	35.4	10.79	5.0	1.5240	-0.19	-0.0239	-0.81
LPB	Low Pressure Boilers	321,731	4,627,239	6558.9	2008.6	167.0	50.9	590.0	583.2	6.4	1.95	12.0	3.6576	-9.58	-1.2075	-42.05
581CH	581 Heater [illegible]	324,658	4,627,224	6592.0	2009.3	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5200	0.22	0.0277	0.98
[illegible]	#3 TGTU	325,390	4,627,690	6597.9	2010.0	100.0	30.5	627.8	604.2	51.9	15.82	3.0	0.9100	0.02	0.0025	0.16
[illegible]	#4 TGTU	325,390	4,627,714	6598.1	2011.1	100.0	30.5	627.8	604.2	51.9	15.82	3.0	0.9100	0.02	0.0025	0.10
[illegible]	#2 Hydrogen Plant Heater H-103	325,772	4,627,500	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	0.00	0.0000	0.00
[illegible]	Cummins [illegible] F20 Pump Engine	325,816	4,627,768	6585.6	2007.6	6.0	1.8	851.0	728.5	[illegible]	118.87	0.3	0.1000	0.08	0.0101	0.35
[illegible]	#11 Boiler	324,776	4,627,776	6589.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5200	0.27	0.0340	1.18
[illegible]	#12 Boiler	324,826	[illegible]	6587.7	2008.5	50.0	15.2	500.0	533.2	[illegible]	26.91	5.0	1.5200	[illegible]	0.0527	1.80
[illegible]	#13 Boiler	324,813	4,627,218	6587.1	2007.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5240	0.16	0.0202	0.70
BEGEN	[illegible] Emergency Generator [illegible]	321,713	4,627,255	6580.9	2005.9	4.6	[illegible]	975.0	797.0	43.0	13.11	0.3	[illegible]	0.00	0.0000	0.00
[illegible]	Asphalt Heater #2	325,781	4,627,231	6583.3	2006.5	42.0	12.8	[illegible]	810.9	14.2	4.32	3.0	0.9144	-0.01	-0.0013	-0.07
[illegible]	[illegible] Emergency Air Comp	324,753	4,627,312	6590.1	2008.7	7.0	2.1	780.0	688.7	[illegible]	[illegible]	0.3	0.1006	-0.73	-0.0920	-3.19
[illegible]	New Air Compressor	324,753	4,627,312	6590.1	2008.7	7.0	2.1	780.0	688.7	[illegible]	[illegible]	0.3	0.1006	0.13	0.0164	[illegible]

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Table B-4
SIA - $PM_{2.5}$ Existing Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		$PM_{2.5}$ Maximum Short Term Emission Rate		$PM_{2.5}$ Annual Emission Rate
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)	(TPY)
HC8HTR	Hydrocracker Heater H8	324,807	4,627,175	6591.8	2010.8	100.0	30.5	830.0	716.5	29.4	8.96	5.5	1.6800	0.00	0.0000	0.00
ALTOTU	#1/#2 TOTU (Sand Bed)	325,001	4,627,228	6588.2	2008.1	100.0	30.5	163.0	345.9	43.9	13.38	2.5	0.7620	-0.01	-0.0013	-0.05
HCH1	#1 HDS H2 Heater 25H720L	324,771	4,627,591	6597.7	2011.0	100.0	30.5	620.0	599.8	64.7	19.72	3.1	0.9449	0.00	0.0000	0.00
HCH2	#1 HDS H2 Heater 25H3H02	324,771	4,627,574	6597.5	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0973	0.00	0.0000	0.00
#11BOIL	#11 Boiler	324,855	4,627,223	6589.3	2008.4	50.0	15.2	500.0	533.2	92.8	28.28	5.0	1.5240	0.31	0.0116	1.45
FCCREGEN	FCCU Regenerator Vent	325,015	4,627,365	6590.9	2008.9	160.0	48.8	460.0	510.9	52.6	16.03	7.2	2.1900	-41.10	-5.1785	-180.73
NAPSPLIT	Naphtha Splitter Heater	324,891	4,627,331	6591.5	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2200	0.03	0.0039	0.11
#1HDSHTR	781 #1 HDS Heater	324,831	4,627,350	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2200	0.02	0.0025	0.10
781LEFH	781 LEF Heater	324,976	4,627,299	6590.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.0	0.9140	0.00	0.0000	0.00
#1REF	781 #1 Reformer Heater	324,817	4,627,360	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5200	0.00	0.0000	0.00
#2REF	781 #2 Reformer Heater	324,816	4,627,380	6591.6	2009.1	155.0	47.5	910.0	761.6	29.4	8.95	5.0	1.5200	0.00	0.0000	0.00
#3REF	781 #3 Reformer Heater	324,813	4,627,160	6591.5	2009.1	65.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2200	0.00	0.0000	0.00
STABIL	781 Stabilizer Heater	324,848	4,627,380	6591.3	2009.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2200	0.00	0.0000	0.00
583VHOLD	583 Vacuum Heater Old Unit	324,565	4,627,231	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	6.0	1.7800	-0.08	-0.0102	-0.35
592HF101	592 Pre-Flash Heater, F101	324,850	4,627,328	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2200	0.00	0.0000	0.00
592HF104	592 Pre-Flash Heater, F104	324,850	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5200	0.00	0.0000	0.00
592H102A	592 Crude Heater, F102A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5200	0.00	0.0000	0.00
592H102B	592 Crude Heater, F102B	324,870	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.1	11.1	3.39	5.0	1.5200	0.00	0.0000	0.00
592VHF104	592 Vacuum Heater, F104	324,665	4,627,348	6591.9	2009.2	120.0	36.6	770.0	683.2	66.6	20.31	3.0	0.9100	0.00	0.0000	0.00
#2HDSHTR	#2 HDS Heater	324,813	4,627,310	6591.4	2009.1	135.0	41.2	370.0	460.9	17.1	5.21	4.0	1.2200	0.00	0.0000	0.00
#4HDSHTR	#4 HDS Heater	324,766	4,627,471	6593.3	2009.6	88.0	26.8	820.0	710.9	52.2	1.72	4.0	1.2200	0.00	0.0000	0.00
68HPBOIL	68 High Pressure Boiler	324,770	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.1	42.5	12.96	5.0	1.5200	-14.18	-1.7866	-62.08
69HPBOIL	69 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	-14.18	-1.7866	-62.08
LOLRFLAR	Light Oil Loading Rack Flare	324,531	4,627,314	6590.9	2008.8	35.0	10.7	390.0	472.0	20.3	3.14	6.0	1.8300	0.00	0.0000	0.00
HCHE602	Hydrocracker Heater H-602	324,732	4,627,186	6595.3	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0400	0.00	0.0000	0.00
HCH4	Hydrocracker Heater E26	324,732	4,627,195	6595.7	2010.4	160.0	48.8	630.0	605.4	35.6	10.85	4.1	1.2500	0.00	0.0000	0.00
H2HTR	Hydrogen Plant Heater H-101	324,809	4,627,512	6595.9	2010.4	100.0	30.5	590.0	583.1	69.7	21.24	6.6	2.0000	0.00	0.0000	0.00
HCH5	Hydrocracker Heater H5	324,857	4,627,473	6594.7	2010.1	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3100	0.00	0.0000	0.00
CATOXL	Catalytic Oxidation Unit	324,327	4,627,303	6593.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	3.2	0.9600	0.00	0.0000	0.00
583VH	583 Vacuum Heater - New Unit	324,385	4,627,253	6589.3	2008.4	327.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2190	0.12	0.0151	0.51
COKERHTR	Coker Heater	325,408	4,627,590	6587.7	2007.9	173.0	54.1	610.0	597.0	31.5	10.51	6.8	2.0700	0.27	0.0340	1.18
COKERFLAR	Coker Flare	325,698	4,627,600	6588.0	2008.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.8	2.3723	0.19	0.0239	0.82
JDFER	John Deere 4045D water treatment pump	329,228	4,628,461	6540.7	1994.5	4.6	1.4	980.0	799.8	108.2	32.99	0.3	0.1000	0.05	0.0063	0.22
HSIHSR	HSI Heater	324,684	4,627,509	6595.1	2010.2	100.0	30.5	111.1	318.3	16.9	5.15	5.6	1.7100	0.09	0.0113	0.11
CATOX	New CatOx	324,327	4,627,393	6593.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	3.2	0.9600	0.00	0.0000	0.00
ALKYH15	Alky Heater H15	325,174	4,627,500	6587.4	2007.8	50.0	15.2	168.0	348.7	2.4	0.73	3.6	1.0973	-0.03	-0.0038	-0.13
ALKYH16	Alky Heater H16	325,174	4,627,464	6586.8	2007.7	50.0	15.2	751.6	673.2	3.6	1.10	4.6	1.4023	0.00	0.0000	0.00
ALKYHE	Alky Heater H1	325,139	4,627,540	6591.1	2009.0	78.4	23.9	825.0	713.7	3.5	1.05	3.3	1.0058	-0.04	-0.0050	-0.18
10HPBOIL	#10 High Pressure Boiler	324,814	4,627,211	6589.2	2008.4	50.0	15.2	150.0	338.7	35.4	10.79	5.0	1.5240	-0.19	-0.0239	-0.83
LPB	Low Pressure Boilers	324,731	4,627,239	6588.9	2008.6	167.0	50.9	500.0	533.2	6.4	1.95	12.0	3.6576	-9.58	-1.2071	-42.00
581HE	581 Heater H101	324,598	4,627,275	6590.0	2008.3	100.0	30.5	550.0	561.2	52.5	15.99	5.0	1.5200	0.18	0.0227	0.82
#3TOTU	#3 TOTU	325,390	4,627,690	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	0.02	0.0025	0.10
#4TOTU	#4 TOTU	325,380	4,627,714	6588.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	0.02	0.0025	0.10
#2H2HTR	#2 Hydrogen Plant Heater H-102	324,712	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.6	2.0000	0.00	0.0000	0.00
CUMMINS	Cummins CLPFE-2 Pump Engine	325,236	4,627,808	6586.6	2007.6	6.0	1.8	871.0	739.3	390.0	118.87	0.3	0.1000	0.08	0.0101	0.35
#11BOIL	#11 Boiler	324,721	4,627,210	6590.9	2008.9	50.0	15.2	300.0	419.8	49.1	14.97	5.0	1.5200	0.27	0.0340	1.18
#12BOIL	#12 Boiler	324,806	4,627,246	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5200	0.41	0.0517	1.80
#13BOIL	#13 Boiler	324,814	4,627,261	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5200	0.16	0.0202	0.70
BEGEN	Bellerhouse Emergency Generator (Q1025A)	324,734	4,627,255	6590.9	2008.9	4.6	1.4	975.0	797.0	15.0	11.81	0.3	0.1000	0.00	0.0000	0.00
ASPHHTR2	Asphalt Heater #2	325,041	4,627,246	6588.3	2008.1	12.0	12.8	1000.0	810.9	11.2	3.42	3.0	0.9144	-0.01	-0.0013	-0.07
EMCOMPR	Bellerhouse Emerg Air Comp	324,756	4,627,232	6590.1	2008.7	7.0	2.1	740.0	666.7	328.0	99.97	0.3	0.1006	-0.73	-0.0920	-0.18
NEWCOMP	New Air Compressor	324,756	4,627,232	6590.1	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	0.13	0.0164	0.03

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Table B-5
SIA - CO Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		Carbon Monoxide Maximum Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
HC0H5	Hydrocracker Heater H5	324,837	4,627,421	6591.1	2009.5	103.0	31.5	850.0	741.1	29.4	8.96	5.3	1.6200	0.00	0.0000
#1TOTLT	41/43 T-6330 (Aux Flare)	325,001	4,627,228	6588.1	2008.1	100.0	30.5	163.0	345.9	43.9	13.38	2.5	0.7620	1.09	0.1373
HCH1	14 HDS H2 Heater 25H-101	324,721	4,627,380	6597.7	2011.0	100.0	30.5	620.0	599.8	65.7	29.72	3.1	0.9449	0.00	0.0000
HCH2	14 HDS H2 Heater 25H-102	324,771	4,627,374	6597.5	2010.9	100.0	30.5	620.0	600.1	12.5	32.95	3.6	1.0973	0.00	0.0000
#4BOIL	#4 Boiler	324,835	4,627,223	6594.3	2009.8	50.0	15.2	500.0	533.2	72.1	21.98	5.0	1.5240	1.01	0.1330
FCCREGEN	FCCU Regenerator Vent	325,018	4,627,166	6590.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1900	0.00	0.0000
NAPSPLIT	Naphtha Splitter Heater	324,891	4,627,332	6591.5	2009.5	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2200	0.45	0.0567
#1HDSHTR	781 #2 HDS Heater	324,831	4,627,310	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2200	0.91	0.0126
781LEFH	781 LEF Heater	324,971	4,627,299	6590.0	2008.6	110.0	33.5	675.0	630.1	21.9	6.68	3.0	0.9100	0.00	0.0000
#1REF	781 #1 Reformer Heater	324,847	4,627,319	6591.4	2009.1	150.0	45.7	870.0	738.6	24.1	7.35	5.0	1.5200	0.00	0.0000
#2REF	781 #2 Reformer Heater	324,836	4,627,310	6591.6	2009.2	133.0	40.5	940.0	777.6	29.4	8.95	5.0	1.5200	0.00	0.0000
#3REF	781 #3 Reformer Heater	324,824	4,627,310	6591.5	2009.2	63.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2200	0.00	0.0000
STABIL	781 Stabilizer Heater	324,848	4,627,310	6591.3	2009.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2200	0.00	0.0000
583VHOLD	583 Vacuum Heater Old Unit	324,865	4,627,233	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2200	-1.70	-0.2142
582HF101	582 Pre-Flash Heater, F101	324,850	4,627,326	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2200	0.00	0.0000
583HF101	583 Pre-Flash Heater, F101	324,840	4,627,328	6591.8	2009.1	120.0	36.6	1100.0	866.5	10.0	3.05	5.0	1.5200	0.00	0.0000
591H02A	591 Crude Heater, F102A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5200	0.50	0.0630
592H02B	592 Crude Heater, F102B	324,870	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5200	0.29	0.0366
582VH104	582 Vacuum Heater, F104	324,865	4,627,331	6591.9	2009.2	120.0	36.6	770.0	683.2	64.5	19.61	3.0	0.9140	0.00	0.0000
#2HDSHTR	#2 HDS Heater	324,815	4,627,310	6591.1	2009.0	135.0	41.2	400.0	477.6	17.1	5.21	4.0	1.2200	0.00	0.0000
#3HDSHTR	#3 HDS Heater	324,765	4,627,374	6591.3	2009.6	70.0	21.3	820.0	710.9	12.2	3.73	4.0	1.2200	0.00	0.0000
#4HPBOIL	4B High Pressure Boiler	324,720	4,627,231	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	0.00	0.0000
#5HPBOIL	5B High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5200	0.00	0.0000
LOADFLAR	Lp29 Oil Loading Rack Flare	324,532	4,627,313	6598.4	2008.8	35.0	10.7	380.0	466.5	10.3	3.14	6.0	1.8300	0.50	0.0630
HCHTR	Hydrocracker Heater H-1R	324,782	4,627,186	6596.5	2010.5	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0400	0.00	0.0000
HCH1	Hydrocracker Heater H1	324,793	4,627,195	6595.9	2010.4	145.0	44.2	630.0	605.4	36.4	11.09	4.1	1.2400	0.00	0.0000
H2PLNTHTR	Hydrogen Plant Heater H-101	324,800	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	0.00	0.0000
HCH5	Hydrocracker Heater H5	324,857	4,627,473	6596.7	2010.6	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3100	0.00	0.0000
CATOX1	Catalytic Oxidation Unit	324,327	4,627,393	6598.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3660	0.00	0.0000
583VH	583 Vacuum Heater - New Unit	324,836	4,627,335	6589.4	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	2.60	0.3276
COKERHTR	Coker Heater	325,606	4,627,390	6587.7	2007.9	175.0	53.3	615.0	597.0	34.5	10.53	6.8	2.0700	5.80	0.7308
COKRFLAR	Coker Flare	325,635	4,627,691	6588.0	2006.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.8	2.3713	37.00	4.6619
JDFFR	[illegible] 4045D water transfer pump	329,222	4,628,463	6543.7	1994.5	4.6	1.4	990.0	799.8	131.2	39.99	0.3	0.1000	0.58	0.0731
BSIHTR	BSI Heater	324,834	4,627,508	6596.1	2010.2	100.0	30.5	313.5	429.3	16.9	5.15	5.6	1.7100	2.00	0.2520
CATOX	New CatOx	324,320	4,627,398	6599.3	2011.7	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3660	0.09	0.0113
ALKYH15	Alky Heater H15	325,171	4,627,500	6587.4	2007.8	50.0	15.2	750.0	672.1	2.4	0.73	3.6	1.0973	-0.70	-0.0882
ALKYH16	Alky Heater H16	325,174	4,627,464	6586.8	2007.7	50.0	15.2	752.0	673.2	3.6	1.10	4.6	1.4021	0.00	0.0000
ALKYHTR	Alky Heater H8	325,134	4,627,540	6591.1	2009.0	78.4	23.9	825.0	713.7	3.5	1.05	3.3	1.0058	[illegible]	[illegible]
#10HPBOIL	#10 High Pressure Boiler	324,814	4,627,211	6589.2	2008.4	50.0	15.2	350.0	449.8	35.1	10.70	5.0	1.5240	-4.00	-0.5040
LPB	Low Pressure Boilers	324,735	4,627,219	6589.9	2008.6	167.0	50.9	500.0	533.2	6.4	1.95	12.0	3.6576	0.00	0.0000
58BLR	58 Boiler 13T604	324,603	4,627,335	6589.6	2008.5	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5200	4.02	0.5065
#3TGTU	#3 T6330	325,300	4,627,690	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	3.33	0.4423
#4TGTU	#4 T6330	325,300	4,627,724	6588.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9100	3.31	0.4171
#2H2HTR	#2 Hydrogen Plant Heater H-102	324,722	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0600	-0.01	-0.0050
CUMMINS	Cummins CI PB13 Emergency Pump Engine	325,216	4,627,208	6585.6	2007.6	6.0	1.8	810.0	705.4	350.0	106.67	0.3	0.1000	0.56	0.0706
#1EBOIL	#1E Boiler	324,771	4,627,250	6590.9	2008.9	50.0	15.2	350.0	449.8	49.1	15.00	5.0	1.5200	5.80	0.7308
#12BOILER	#12 Boiler	324,826	4,627,231	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5200	8.80	1.1063
#13BOIL	#13 Boiler	324,814	4,627,241	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5240	1.17	0.1452
BKGEN	Boilerhouse Emergency Generator (Q1023A)	324,713	4,627,255	6590.9	2008.9	4.6	1.4	975.0	797.0	49.0	15.11	0.3	0.1000	38.70	4.8862
ASPHH02	Asphalt Heater #2	325,081	4,627,211	6586.3	2008.1	42.0	12.8	1004.0	813.9	14.3	4.36	3.0	0.9144	-0.66	-0.0831
BHCOMPRS	Boilerhouse Emerg. Air Comp	324,753	4,627,232	6590.3	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	-2.20	-0.2772
NEWACOM	New Air Compressor	324,753	4,627,232	6590.3	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	2.29	0.2885

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APPENDIX C
NAAQS/WAAQS CUMULATIVE MODEL INPUTS

The following attachments are included in this appendix in the following order:

- Table C-1: Cumulative Analysis – NO_2 Emitting Sources (1-hr Average)
- Table C-2: Cumulative Analysis – NO_2 Emitting Sources (Annual Average)
- Table C-3: Cumulative Analysis – SO_2 Emitting Sources
- Table C-4: Cumulative Analysis – $PM_{2.5}$ Emitting Sources
- Table C-5: Cumulative Analysis – CO Emitting Sources

Table C-1
Cumulative Analysis - NO_2 Emitting Sources (1-hr Average)
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		NO_x Maximum Hourly Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
HCHH3	Hydrocracker Heater H3	324,837	4,627,473	6591.8	2009.1	110.0	33.5	880.0	744.3	29.1	8.96	5.3	1.6185	2.00	0.2520
41TGIU	41/42 TGIU (Scrubber)	325,401	4,627,728	6558.2	2003.1	100.0	30.5	163.0	345.9	45.9	13.38	2.5	0.7620	0.46	0.0580
HCH2	#1 HDS H2 Heater 251TH01	324,731	4,627,588	6597.7	2011.0	100.0	30.5	620.0	599.8	64.7	19.72	3.1	0.9449	0.80	0.1008
HCH3	#1 HDS H2 Heater 251TH02	324,771	4,627,574	6591.5	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0973	0.81	0.1098
914BOIL	#14 Boiler	324,855	4,627,221	6589.3	2008.5	50.0	15.2	500.0	533.2	78.1	23.95	5.0	1.5240	1.80	0.2268
FCCREGEN	FCCU Regenerator Vent	325,013	4,627,365	6590.9	2008.9	100.0	30.5	360.0	508.9	52.6	16.03	7.2	2.1945	30.90	3.8429
NAPSPLIT	Naphtha Splitter Heater	324,891	4,627,335	6591.5	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2192	1.61	0.2042
YHDSHTR	282 #1 HDS Heater	324,831	4,627,310	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2192	1.17	0.1474
781LEFH	781 LEF Heater	324,974	4,627,299	6590.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.0	0.9144	0.80	0.1008
91REF	785 01 Reformer Heater	324,837	4,627,310	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5240	1.60	0.2016
92REF	785 02 Reformer Heater	324,816	4,627,310	6591.6	2009.1	133.0	40.5	940.0	777.6	29.4	8.95	5.0	1.5240	2.60	0.3276
93REF	785 03 Reformer Heater	324,824	4,627,310	6591.5	2009.1	63.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2192	0.80	0.1008
STABIL	781 Stabilizer Heater	324,848	4,627,310	6591.3	2009.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2192	0.40	0.0504
582PF101	582 Pre-Flash Heater, F101	324,853	4,627,344	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2192	3.20	0.4032
582HF103	582 Pre-Flash Heater, F103	324,810	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5240	3.80	0.4788
582H102A	582 Crude Heater, F102A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5240	8.60	1.0836
582H102B	582 Crude Heater, F102B	324,870	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5240	3.40	0.4284
582VH104	582 Vacuum Heater, F104	324,865	4,627,348	6591.9	2009.2	120.0	36.6	770.0	683.2	64.4	19.64	3.0	0.9144	9.00	1.1340
42HDSHTR	#2 HDS Heater	324,833	4,627,310	6591.4	2009.1	135.0	41.2	300.0	422.0	17.1	5.21	4.0	1.2192	1.00	0.1260
43HDSHTR	#3 HDS Heater	324,765	4,627,374	6593.3	2009.6	78.0	23.8	320.0	710.9	12.2	3.73	4.0	1.2192	0.60	0.0756
88HPBOIL	#8 High Pressure Boiler	324,770	4,627,293	6590.6	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	23.00	2.8980
89HPBOIL	#9 High Pressure Boiler	324,779	4,627,293	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	23.00	2.8980
LORFLAR	Light Oil Loading Rack Flare	324,332	4,627,314	6593.9	2009.8	35.0	10.7	379.0	465.9	10.3	3.14	6.0	1.8288	0.19	0.0239
HCH1/H2	Hydrocracker Heater H1/H2	324,742	4,627,486	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.1	1.0391	1.30	0.1648
HCH4	Hydrocracker Heater H4	324,782	4,627,495	6595.7	2010.4	143.0	43.6	630.0	605.4	36.1	11.69	4.3	1.3106	2.00	0.2520
41H2HTR	#1 Hydrogen Plant Heater	324,800	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0604	18.72	2.3587
HCH5	Hydrocracker Heater H5	324,857	4,627,473	6594.7	2010.1	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3106	1.57	0.1980
583VH	583 Vacuum Heater - New Unit	324,855	4,627,233	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	1.91	0.2427
COKERHTR	Coker Heater	325,101	4,627,750	6587.7	2007.9	175.0	53.3	615.0	597.0	34.6	10.55	6.8	2.0696	4.80	0.6048
COKEFLAR	Coker Flare	325,658	4,627,699	6583.0	2006.5	175.0	53.3	1831.7	1273.0	65.6	20.00	7.8	2.3773	6.80	0.8568
DEERE	John Deere 4045D water transfer pump	329,721	4,628,463	6543.7	1994.5	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.1006	0.56	0.0706
DSHTR	DSI Heater	324,604	4,627,509	6595.5	2010.2	100.0	30.5	123.3	323.3	16.9	5.15	5.6	1.7069	1.50	0.1890
CATOX	New CatOx	324,327	4,627,391	6598.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3597	0.12	0.0151
583CH	583 Heater HT204	324,898	4,627,223	6589.0	2008.3	100.0	30.5	100.0	533.2	52.3	15.99	5.0	1.5240	6.99	0.8807
43TGIU	#3 TGIU	325,300	4,627,650	6587.9	2008.0	100.0	30.5	627.8	601.2	51.9	15.81	3.0	0.9144	0.82	0.1033
41TGIU	#1 TGIU	325,360	4,627,784	6588.3	2008.1	100.0	30.5	627.8	601.2	51.9	15.81	3.0	0.9144	0.82	0.1033
42H2HTR	#2 Hydrogen Plant Heater H-102	324,778	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0604	2.90	0.3654
411BOIL	#11 Boiler	324,771	4,627,230	6590.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5240	5.20	0.6552
412BOILR	#12 Boiler	324,826	4,627,233	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5240	2.20	0.2772
413BOIL	#13 Boiler	324,811	4,627,218	6589.2	2008.4	50.0	15.2	500.0	533.2	31.9	10.65	5.0	1.5240	0.87	0.1096
ASPHHTR	Asphalt Heater #1	325,036	4,627,344	6585.3	2008.1	42.0	12.8	1060.0	810.9	14.2	4.33	3.0	0.9144	1.84	0.2318
780FCCH3	780 FCC Heater H3	324,944	4,627,350	6591.4	2009.1	110.0	33.5	650.0	616.5	13.5	4.11	3.0	0.9144	2.30	0.2898
780FCCH2	780 FCC Heater H2	324,981	4,627,300	6590.0	2008.6	110.0	33.5	750.0	672.0	41.0	12.56	2.5	0.7590	4.46	0.5620
CG_1	Dresser-Clark TLAS-6	328,828	4,624,655	6503.2	1982.2	35.0	10.7	699.5	611.0	102.0	31.10	1.7	0.5300	48.00	6.0480
CG_2	Dresser-Clark TLAS-6	328,828	4,624,646	6503.9	1982.1	35.0	10.7	699.5	611.0	102.0	31.10	1.7	0.5300	48.00	6.0480
CG_3	Dresser-Clark TLAS-6	328,828	4,624,637	6502.7	1982.0	35.0	10.7	699.5	614.0	102.0	31.10	1.7	0.5300	48.00	6.0480
CG_4	Dresser-Clark TLAS-6	328,828	4,624,628	6502.6	1982.0	35.0	10.7	699.5	644.0	102.0	31.10	1.7	0.5300	63.98	8.0610
CG_5	Dresser-Clark TLAS-6	328,828	4,624,622	6502.5	1982.0	26.0	7.9	699.5	644.0	136.2	41.50	1.7	0.5300	10.60	1.3360

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Table 13-1
Cumulative Analysis - NO_x Emitting Sources (1-hr Average)
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		NO_x Maximum Hourly Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
1E_1A	White-Sup. 8GT-825	328,857	4,624,594	6501.3	1981.6	18.0	5.5	699.5	644.0	59.0	17.98	1.0	0.3400	3.97	0.5000
1E_1B	White-Sup. 8GT-825	328,832	4,624,581	6501.4	1981.6	18.0	5.5	699.5	644.0	59.0	17.98	1.0	0.3400	3.97	0.5000
1E_1C	White-Sup. 8GT-825	328,816	4,624,581	6501.5	1981.7	18.0	5.5	699.5	644.0	59.0	17.98	1.0	0.3400	3.97	0.5000
1E_1D	White-Sup. 8GT-825	328,810	4,624,581	6501.8	1981.8	18.0	5.5	699.5	644.0	59.0	17.98	1.0	0.3400	4.40	0.5540

Table C-1
Cumulative Analysis - NO_x Emitting Sources (Annual Average)
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		NO_x Annual Emission Rate
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(TPY)
HCUH3	Hydrocracker Heater H3	324,837	4,627,173	6591.8	2010.1	110.0	33.5	650.0	616.3	29.4	8.96	5.3	1.6155	8.76
31TGTU	#1/#2 TGTU (Scrubber)	325,606	4,627,228	6585.2	2008.1	100.0	30.5	163.0	345.9	43.9	13.38	2.5	0.7620	2.02
HCS51	#55DS H2 Heater 25HTE01	324,778	4,627,588	6597.7	2011.0	100.0	30.5	620.0	599.8	64.7	19.72	3.1	0.9449	3.50
HCS52	#55DS H2 Heater 25HTE02	324,776	4,627,571	6597.5	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0973	3.68
414BOIL	#14 Boiler	324,855	4,627,223	6589.3	2008.4	50.0	15.2	500.0	533.2	72.1	21.98	5.0	1.5240	7.83
FCCREGEN	FCCU Regenerator Vent	325,013	4,627,365	6590.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1946	66.60
NAPSPLH	Naphtha Splitter Heater	324,898	4,627,333	6591.3	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2192	7.30
781HDSHTR	781 #1 HDS Heater	324,834	4,627,310	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2192	5.82
781LPFH	781 LPF Heater	324,971	4,627,299	6590.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.0	0.9144	3.50
1REF	781 #1 Reformer Heater	324,837	4,627,310	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5240	7.08
2REF	781 #2 Reformer Heater	324,816	4,627,310	6591.6	2009.1	133.0	40.5	940.0	777.6	29.4	8.95	5.0	1.5240	11.39
3REF	781 #3 Reformer Heater	324,824	4,627,310	6591.5	2009.1	63.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2192	3.50
STABIL	781 Stabilizer Heater	324,843	4,627,310	6591.3	2009.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2192	1.75
582PF101	582 Pre-Flash Heater, F101	324,853	4,627,328	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2192	14.02
582PF103	582 Pre-Flash Heater, F103	324,810	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5240	16.64
582H202A	582 Crude Heater, F202A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5240	37.67
582H202B	582 Crude Heater, F202B	324,810	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5240	14.80
582VH104	582 Vacuum Heater, F104	324,865	4,627,333	6591.9	2009.2	120.0	36.6	770.0	683.2	64.4	19.64	3.0	0.9144	39.42
#2HDSHTR	#2 HDS Heater	324,813	4,627,310	6591.4	2009.1	135.0	41.2	300.0	422.0	17.1	5.21	4.0	1.2192	4.34
#3HDSHTR	#3 HDS Heater	324,765	4,627,374	6593.3	2009.6	78.0	23.8	820.0	710.9	12.2	3.71	4.0	1.2192	2.63
#8HPBOIL	#8 High Pressure Boiler	324,770	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	100.71
#9HPBOIL	#9 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	100.71
LOLRFLAR	Light Oil Loading Rack Flare	324,532	4,627,218	6593.9	2009.8	35.0	10.7	379.0	465.9	10.3	3.14	6.0	1.8288	0.83
HCHH1H2	Hydrocracker Heater H1/H2	324,782	4,627,186	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0591	5.69
HCH4	Hydrocracker Heater H4	324,782	4,627,495	6595.7	2010.4	141.0	43.0	630.0	605.4	36.4	11.09	4.3	1.3106	8.76
2H2HTR	#2 Hydrogen Plant Heater	324,800	4,627,512	6595.9	2010.4	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0601	31.99
HCH5	Hydrocracker Heater H5	324,857	4,627,473	6596.7	2010.1	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3106	6.88
583VH	583 Vacuum Heater - New Unit	324,865	4,627,233	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	8.44
COKERHTR	Coker Heater	325,405	4,627,750	6587.7	2007.9	175.0	53.3	615.0	597.0	31.6	10.53	6.8	2.0726	11.02
COKEFLAR	Coker Flare	325,658	4,627,609	6583.0	2006.5	175.0	53.3	1832.7	1273.0	65.6	20.00	7.8	2.3773	19.74
JDEER	John Deere 6015D water transfer pump	329,728	4,628,463	6543.7	1994.5	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.1006	2.15
BSIHTR	BSI Heater	324,894	4,627,169	6595.1	2010.2	100.0	30.5	171.3	350.5	16.9	5.15	5.6	1.7069	6.57
CATOX	New CatOx	324,327	4,627,193	6598.1	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3597	0.51
583CH	583 Heater H1101	324,898	4,627,223	6589.0	2008.3	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5240	30.62
#3TGTU	#3 TGTU	325,390	4,627,690	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9144	3.59
#1TGTU	#1 TGTU	325,360	4,627,724	6593.3	2009.6	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9144	3.59
#2H2HTR	#2 Hydrogen Plant Heater H-102	324,722	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0601	12.70
CUMMINS	Cummins CFP11E-F20 Pump Engine	325,216	4,627,268	6586.6	2007.6	6.0	1.8	844.0	724.3	390.0	118.87	0.3	0.1006	15.99
#11BOIL	#11 Boiler	324,772	4,627,270	6590.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5240	22.74
#12BOILR	#12 Boiler	324,806	4,627,233	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5240	9.61
#13BOIL	#13 Boiler	324,814	4,627,213	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.63	5.0	1.5240	3.81
BLGEN	Boilerhouse Emergency Generator (QT025A)	324,714	4,627,255	6590.9	2008.9	4.6	1.4	975.0	797.0	43.0	13.61	0.3	0.1006	0.18
ASPHH#1	Asphalt Heater #1	325,036	4,627,218	6588.1	2008.1	42.0	12.8	1000.0	810.9	14.2	4.32	3.0	0.9144	8.06
#5GEN	#5 Generator	324,818	4,627,226	6590.5	2008.5	30.0	9.1	500.0	533.2	32.1	9.77	1.5	0.4602	6.21
780FCCB3	780 FCC Heater B3	324,944	4,627,350	6591.6	2009.1	110.0	33.5	690.0	638.7	13.5	4.11	3.0	0.9144	10.07
780FCCB2	780 FCC Heater B2	324,986	4,627,300	6590.0	2008.6	110.0	33.5	750.0	672.0	42.0	12.81	2.5	0.7590	19.53
EMCOMS51	Boilerhouse Emerg Air Comp	324,751	4,627,238	6590.2	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	1.37
EMCOMS10	Boilerhouse Emerg Air Comp	324,768	4,627,244	6590.4	2008.7	7.0	2.1	990.0	772.0	354.0	107.90	0.3	0.1006	3.60
NEWCOMP	Boilerhouse Emerg Air Comp	324,753	4,627,232	6590.1	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	0.66

Table C-1
Cumulative Analysis - NO_x Emitting Sources (Annual Average)
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		NO_x Annual Emission Rate
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(TPY)
CG_1	Dresser-Clark TLAS-6	328,828	4,624,655	6503.2	1982.2	35.0	10.7	692.5	640.0	102.0	31.10	1.7	0.5300	210.24
CG_2	Dresser-Clark TLAS-6	328,829	4,624,616	6502.9	1982.1	35.0	10.7	692.5	640.0	102.0	31.10	1.7	0.5300	210.21
CG_3	Dresser-Clark TLAS-6	328,828	4,624,637	6502.7	1982.0	35.0	10.7	692.5	640.0	102.0	31.10	1.7	0.5300	210.21

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Table C-3
Cumulative Analysis - SO_2 Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		SO_2 Maximum Hourly Emission Rate		SO_2 Maximum Short Term Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)	(lb/hr)	(g/s)
HCUH3	Hydrocracker Heater H3	324,837	4,627,473	6594.8	2010.1	110.0	33.5	880.0	744.3	29.4	8.96	5.3	1.6183	1.30	0.1638	1.30	0.1638
#1TGTU	#1/#2 TGTU (Scrubber)	325,091	4,627,228	6585.2	2007.1	100.0	30.5	361.0	455.9	43.9	13.38	2.5	0.7620	7.06	0.8896	7.06	0.8896
HCHE	#2 HDS 882 Heater 25HT101	324,771	4,627,588	6597.7	2011.0	100.0	30.5	620.0	599.8	64.7	19.72	3.2	0.9819	0.50	0.0630	0.50	0.0630
HCHE3	#4 HDS 887 Heater 25HT101	324,771	4,627,575	6597.5	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0973	0.60	0.0756	0.60	0.0756
#11BOIL	#11 Boiler	324,855	4,627,223	6589.3	2008.4	50.0	15.2	500.0	533.2	72.1	21.98	5.0	1.5240	4.20	0.5292	4.20	0.5292
FCCREGEN	FCCU Regenerator Vent	325,083	4,627,365	6590.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1951	26.49	3.3375	26.49	3.3375
NAPSPLIT	Naphtha Splitter Heater	324,891	4,627,338	6591.5	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2192	1.09	0.1374	1.09	0.1371
#3HDSHTR	783 #3 HDS Heater	324,801	4,627,330	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2192	0.79	0.0995	0.79	0.0995
781LEFH	781 LEF Heater	324,973	4,627,259	6590.0	2008.6	110.0	33.5	675.0	630.4	21.9	6.68	3.0	0.9144	0.56	0.0712	0.56	0.0712
#1REF	781 #1 Reformer Heater	324,837	4,627,330	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5240	1.00	0.1260	1.00	0.1260
#2REF	781 #2 Reformer Heater	324,816	4,627,330	6591.6	2009.1	133.0	40.5	910.0	727.6	29.4	8.93	5.0	1.5240	1.70	0.2142	1.70	0.2142
#3REF	781 #3 Reformer Heater	324,814	4,627,330	6591.5	2009.1	63.0	19.2	1080.0	855.4	9.6	2.92	4.0	1.2192	0.50	0.0630	0.50	0.0630
STABIL	782 Stabilizer Heater	324,819	4,627,330	6591.3	2009.0	135.0	41.1	685.0	635.9	8.7	2.65	4.0	1.2192	0.30	0.0378	0.30	0.0378
582HF101	582 Pre-Flash Heater, F101	324,833	4,627,328	6591.7	2009.2	120.0	36.6	1038.0	838.7	15.0	4.56	4.0	1.2192	0.60	0.0756	0.60	0.0756
582HF103	582 Pre-Flash Heater, F103	324,810	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.96	5.0	1.5240	0.40	0.0504	0.40	0.0504
582HF102A	582 Crude Heater, F102A	324,847	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5240	1.00	0.1260	1.00	0.1260
582HF102B	582 Crude Heater, F102B	324,870	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5240	0.40	0.0504	0.40	0.0504
582VHF104	582 Vacuum Heater, F104	324,865	4,627,318	6591.9	2009.2	120.0	36.6	770.0	683.2	64.4	19.64	3.0	0.9144	1.00	0.1260	1.00	0.1260
#2HDSHTR	#2 HDS Heater	324,843	4,627,330	6591.4	2009.1	135.0	41.1	300.0	422.0	17.1	5.21	4.0	1.2192	0.60	0.0756	0.60	0.0756
#3HDSHTR	#3 HDS Heater	324,765	4,627,374	6593.3	2009.6	78.0	23.8	820.0	710.9	12.2	3.73	4.0	1.2192	0.40	0.0504	0.40	0.0504
#8HPBOIL	#8 High Pressure Boiler	324,770	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	2.35	0.2961	2.35	0.2961
#9HPBOIL	#9 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	2.35	0.2961	2.35	0.2961
HCHEH1H2	Hydrocracker Heater H1/H2	324,782	4,627,486	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0394	0.90	0.1131	0.90	0.1131
HCHE4	Hydrocracker Heater H4	324,787	4,627,495	6595.7	2010.4	141.0	43.0	630.0	605.4	36.8	11.40	4.3	1.3106	1.30	0.1638	1.30	0.1638
#3H2PHTR	#3 Hydrogen Plant Heater	324,800	4,627,512	6595.9	2010.4	100.0	30.5	140.0	333.2	69.7	21.24	6.6	2.0094	0.11	0.0136	0.11	0.0136
HCHE5	Hydrocracker Heater H5	324,837	4,627,473	6594.7	2010.1	135.0	41.1	450.0	505.3	22.9	6.98	4.3	1.3106	1.06	0.1332	1.06	0.1332
583VH	583 Vacuum Heater - New Unit	324,815	4,627,233	6589.1	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	1.51	0.1903	1.51	0.1903
COKERHTR	Coker Heater	325,001	4,627,250	6587.7	2007.9	175.0	53.3	615.0	597.0	34.6	10.55	6.6	2.0086	3.40	0.4284	3.40	0.4284
COKEFLAR	Coker Flare	325,658	4,627,092	6583.0	2006.5	110.0	33.5	1832.7	1273.0	65.6	20.00	7.8	2.3713	2.35	0.2967	2.35	0.2967
JDFPR	John Deere 4045D water fire pump	329,221	4,628,463	6545.7	1995.1	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.1006	0.02	0.0025	0.02	0.0025
BSIHTR	BSI Heater	324,694	4,627,920	6595.6	2010.2	100.0	30.5	313.3	428.3	16.9	5.15	5.6	1.7099	0.44	0.0549	0.44	0.0549
CATOX	New CatOx	324,527	4,627,393	6596.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.05	1.2	0.3657	0.00	0.0001	0.00	0.0001
581CH	581 Heater HTF001	324,698	4,627,223	6589.6	2008.5	100.0	30.5	500.0	533.2	52.5	15.92	5.0	1.5240	3.49	0.0912	3.49	0.0912
#3TGTU	#3 TGTU	325,100	4,627,650	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9144	12.57	1.5841	12.57	1.5841
#4TGTU	#4 TGTU	325,350	4,627,721	6588.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.81	3.0	0.9144	12.57	1.5816	12.57	1.5816
#2H2HTR	#2 Hydrogen Plant Heater H-102	324,772	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.8	2.0604	1.27	0.1606	1.27	0.1606
#11BOIL	#11 Boiler	324,771	4,627,270	6590.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5240	3.40	0.4284	3.40	0.4284
#12BOILR	#12 Boiler	324,836	4,627,233	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5240	5.20	0.6552	5.20	0.6552
#13BOIL	#13 Boiler	324,868	4,627,221	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5240	2.00	0.2520	2.00	0.2520
ASPHOTH	Asphalt Heater #1	325,036	4,627,211	6588.3	2008.1	42.0	12.8	1000.0	810.9	14.3	4.35	3.0	0.9144	0.20	0.0252	0.20	0.0252
780FCCH1	780 FCC Heater H1	324,918	4,627,350	6591.4	2009.1	110.0	33.5	650.0	616.5	13.5	4.11	3.0	0.9144	0.24	0.0297	0.24	0.0297
780FCCH2	780 FCC Heater H2	324,981	4,627,300	6590.0	2008.6	110.0	33.5	750.0	672.0	42.0	12.81	2.5	0.7620	0.46	0.0576	0.46	0.0576
WSP3	Wyoming State Pen	315,945	4,625,877	6712.9	2046.1	36.0	11.0	425.0	491.5	27.1	8.26	2.8	0.8535	18.69	2.3601	18.69	2.3601
WSP2	Wyoming State Pen	315,916	4,625,810	6712.8	2046.1	36.0	11.0	435.0	497.0	27.1	8.26	2.8	0.8595	48.10	6.0605	48.10	6.0605
WSP1	Wyoming State Pen	315,947	4,625,851	6712.7	2046.0	20.0	6.1	550.0	560.9	60.9	18.56	2.5	0.7620	48.10	6.0605	48.10	6.0605
EMCOM5352	Boilerhouse Emerg Air Comp	324,753	4,627,338	6590.2	2008.7	7.0	2.1	760.0	695.7	328.0	99.97	0.3	0.1006	0.00	0.0000	0.13	0.0164
EMCOM5370	Boilerhouse Emerg Air Comp	324,761	4,627,216	6590.4	2008.7	7.0	2.1	930.0	772.0	354.0	107.90	0.3	0.1006	0.00	0.0003	0.16	0.0202
NEWCOMP	Boilerhouse Emerg Air Comp	324,753	4,627,342	6590.1	2008.7	7.0	2.1	780.0	688.7	328.0	99.97	0.3	0.1006	0.00	0.0000	0.14	0.0176
REGEN	Boilerhouse Emergency Generator (QE025A)	324,764	4,627,255	6590.9	2008.9	4.6	1.4	975.0	797.0	43.0	13.11	0.3	0.1006	0.00	0.0000	0.00	0.0000
#5GEN	#5 Generator	324,881	4,627,214	6589.5	2008.5	30.0	9.1	500.0	533.2	32.1	9.77	1.5	0.4572	0.00	0.0000	0.81	0.1021
CUMMINS	Cummins CFP11E-F20 Pump Engine	325,236	4,627,268	6586.6	2007.6	6.0	1.8	844.0	724.3	390.0	118.87	0.3	0.1006	0.00	0.0000	0.14	0.0176

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Table C-1
Cumulative Analysis - PM_{10} Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		PM_{10} Maximum Short Term Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	Avg F	Avg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
HCH3H	Hydrocracker Heater H3	324,837	4,627,473	6594.5	2010.1	110.0	33.5	850.0	727.6	29.3	8.96	5.3	1.6185	0.10	0.0126
41TGTUF	#1/#2 TGTU (Scrubber)	325,008	4,627,728	6599.2	2008.1	100.0	30.5	163.0	345.9	13.9	13.38	2.5	0.7620	0.02	0.0025
HCH1	#1 HDS H2 Heater 25H1201	324,776	4,627,581	6602.7	2012.0	100.0	30.5	620.0	599.8	64.7	19.72	3.1	0.9449	0.01	0.0030
HCH3	#4 HDS H2 Heater 25H1102	324,778	4,627,578	6597.3	2010.9	100.0	30.5	630.0	605.4	42.5	12.95	3.6	1.0973	0.04	0.0050
#14BOIL	#14 Boiler	324,855	4,627,223	6589.3	2008.4	50.0	15.2	500.0	533.2	72.1	21.98	5.0	1.5240	0.33	0.0416
LCCREGEN	FCCU Regenerator Vent	325,013	4,627,365	6590.9	2008.9	100.0	30.5	550.0	560.9	52.6	16.03	7.2	2.1945	11.13	1.4020
NAPSPLH	Naphtha Splitter Heater	324,898	4,627,331	6591.5	2009.1	120.0	36.6	400.0	477.6	20.2	6.17	4.0	1.2192	0.09	0.0169
41HDSHTR	781 #1 HDS Heater	324,833	4,627,380	6591.5	2009.1	90.0	27.4	1370.0	1016.5	24.0	7.31	4.0	1.2192	0.06	0.0078
781LEHH	781 LEF Heater	324,974	4,627,399	6590.0	2008.6	110.0	33.5	625.0	603.4	21.9	6.68	3.0	0.9144	0.01	0.0050
#1REF	781 #1 Reformer Heater	324,837	4,627,380	6591.4	2009.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5240	0.08	0.0101
#2REF	781 #2 Reformer Heater	324,816	4,627,380	6591.6	2009.1	131.0	40.5	960.0	727.6	29.4	8.95	5.0	1.5240	0.14	0.0176
#3REF	781 #3 Reformer Heater	324,824	4,627,380	6591.5	2009.1	62.0	19.1	1060.0	833.4	9.6	2.92	4.0	1.2192	0.04	0.0050
STABIL	781 Stabilizer Heater	324,868	4,627,380	6591.3	2009.0	135.0	41.2	635.0	615.9	8.7	2.65	4.0	1.2192	0.02	0.0025
582HF101	582 Pre-Flash Heater, F101	324,853	4,627,328	6591.7	2009.2	120.0	36.6	1050.0	838.7	15.0	4.56	4.0	1.2192	0.14	0.0176
582HF103	582 Pre-Flash Heater, F103	324,849	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5240	0.30	0.1058
582H102A	582 Crude Heater, F102A	324,817	4,627,328	6591.8	2009.2	120.0	36.6	930.0	772.0	19.5	5.93	5.0	1.5240	0.23	0.0290
582H102B	582 Crude Heater, F102B	324,876	4,627,328	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5240	0.07	0.0088
582VH104	582 Vacuum Heater, F104	324,863	4,627,343	6591.9	2009.2	120.0	36.6	760.0	680.2	61.8	19.61	3.0	0.9144	0.24	0.0302
#2HDSHTR	#2 HDS Heater	324,841	4,627,310	6591.4	2009.1	135.0	41.2	300.0	422.0	17.1	5.21	4.0	1.2192	0.05	0.0063
#3HDSHTR	#3 HDS Heater	324,765	4,627,176	6593.3	2009.6	78.0	23.8	820.0	710.9	12.2	3.73	4.0	1.2192	0.03	0.0038
48HPBOIL	48 High Pressure Boiler	324,778	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	0.19	0.0239
49HPBOIL	49 High Pressure Boiler	324,779	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	0.19	0.0239
HCEBH2	Hydrocracker Heater EB852	324,802	4,627,486	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.4	1.0396	0.07	0.0088
HCH4	Hydrocracker Heater H4	324,782	4,627,495	6595.7	2010.4	144.0	43.9	630.0	605.4	36.4	11.09	4.3	1.3106	0.11	0.0139
H2PLHTR	#1 Hydrogen Plant Heater	324,809	4,627,512	6595.9	2010.1	100.0	30.5	500.0	533.2	69.7	21.24	6.6	2.0094	0.50	0.0630
HCH5	Hydrocracker Heater H5	324,857	4,627,471	6594.7	2010.1	135.0	41.2	610.0	594.3	22.9	6.98	4.3	1.3106	0.08	0.0105
583VH	583 Vacuum Heater - New Unit	324,885	4,627,233	6589.3	2008.4	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	0.12	0.0151
COKERHTR	Coker Heater	325,405	4,627,750	6587.7	2007.9	125.0	38.1	615.0	597.0	31.6	10.53	6.6	2.0116	0.27	0.0340
COKELAR	Coker Flare	325,692	4,627,679	6583.0	2006.5	175.0	53.3	1831.7	1273.6	65.6	20.00	7.8	2.3715	0.19	0.0235
JDEER	John Deere 4045D water transfer pump	329,726	4,628,463	6543.7	1994.5	4.6	1.4	980.0	799.8	131.2	39.99	0.3	0.1006	0.05	0.0063
BSHTR	BSE Heater	324,891	4,627,509	6595.1	2010.2	100.0	30.5	513.3	540.3	16.9	5.15	5.6	1.7069	0.09	0.0112
CATOX	New CatOx	324,337	4,627,303	6598.3	2011.2	15.0	4.6	650.0	616.5	10.0	3.04	1.2	0.3597	0.00	0.0003
586CH	586 Heater EF104	324,898	4,627,774	6590.0	2008.3	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5240	0.43	0.0547
43TGTU	#3 TGTU	325,390	4,627,650	6587.9	2008.0	100.0	30.5	627.8	604.2	51.9	15.83	3.0	0.9144	0.02	0.0028
44TGTU	#4 TGTU	325,360	4,627,724	6588.3	2008.1	100.0	30.5	627.8	604.2	51.9	15.83	3.0	0.9144	0.02	0.0028
#2H2PLHTR	#2 Hydrogen Plant Heater H-102	324,732	4,627,507	6596.3	2010.6	100.0	30.5	500.0	533.2	69.7	21.24	6.6	2.0094	0.54	0.0680
CUMMENS	Cummins CLP110-F20 Pump Engine	325,216	4,627,268	6586.6	2007.6	6.0	1.8	864.0	735.3	390.0	118.87	0.3	0.1006	0.08	0.0101
#11BOIL	#11 Boiler	324,778	4,627,270	6590.9	2008.9	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5240	0.27	0.0340
#12BOILR	#12 Boiler	324,876	4,627,233	6589.7	2008.5	50.0	15.2	500.0	533.2	88.3	26.91	5.0	1.5240	0.41	0.0517
#13BOIL	#13 Boiler	324,814	4,627,218	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5240	0.16	0.0202
BHGEN	Boilerhouse Emergency Generator (Q1025A)	324,713	4,627,255	6590.9	2008.9	4.6	1.4	975.0	797.0	43.0	13.11	0.3	0.1006	0.00	0.0000
ASPHH2	Asphalt Heater #2	325,036	4,627,284	6588.3	2008.1	42.0	12.8	1000.0	810.9	14.2	4.32	3.0	0.9144	0.01	0.0019
#5GEN	#5 Generator	324,810	4,627,224	6589.5	2008.5	30.0	9.1	500.0	533.2	32.1	9.77	1.5	0.4602	0.91	0.1147
780FCCH3	780 FCC Heater H3	324,911	4,627,350	6591.4	2009.1	110.0	33.5	650.0	616.5	13.5	4.13	3.0	0.9144	0.02	0.0025
780FCCH2	780 FCC Heater H2	324,981	4,627,300	6590.0	2008.6	110.0	33.5	750.0	672.0	41.0	12.50	2.5	0.7620	0.04	0.0050
EMCOMS52	Boilerhouse Emerg Air Comp	324,753	4,627,238	6590.2	2008.7	7.0	2.1	760.0	658.7	328.0	99.97	0.3	0.1006	0.09	0.0113
EMCOMS70	Boilerhouse Emerg Air Comp	324,761	4,627,244	6590.4	2008.7	7.0	2.1	930.0	772.0	354.0	107.90	0.3	0.1006	0.11	0.0139
NEWCOM	Boilerhouse Emerg Air Comp	324,753	4,627,232	6590.1	2008.7	7.0	2.1	760.0	658.7	328.0	99.97	0.3	0.1006	0.13	0.0164
WSP1	Wyoming State Pen	325,945	4,625,879	6712.9	2046.1	36.0	11.0	425.0	491.5	27.1	8.26	2.8	0.8595	2.10	0.2646
WSP2	Wyoming State Pen	325,946	4,625,880	6712.8	2046.1	36.0	11.0	435.0	497.0	27.1	8.26	2.8	0.8595	3.00	0.3780
WSP3	Wyoming State Pen	325,947	4,625,880	6712.7	2046.0	20.0	6.1	550.0	560.9	60.9	18.56	2.5	0.7590	3.00	0.3780

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Table C-4
Cumulative Analysis - PM_{10} Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		PM_{10} Maximum Short Term Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
NEWCOM	New Air Compressor	321,353	-1,611,252	6590.1	2008.7	7.0	2.1	717.0	653.7	328.0	99.97	0.3	0.1006	0.13	0.0164

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Table C-6
Cumulative Analysis - CO Emitting Sources
Point Source Locations, Parameters, and Emission Rates

Source ID	Source Description	X Coord	Y Coord	Elevation		Stack Height		Temperature		Exit Velocity		Stack Diameter		CO Maximum Hourly Emission Rate	
		(meters)	(meters)	(feet)	(meters)	(feet)	(meters)	deg F	deg K	(ft/s)	(m/s)	(feet)	(meters)	(lb/hr)	(g/s)
[illegible]	Hydrocracker Heater H3	324,837	4,627,173	6595.8	2010.1	[illegible]	39.5	880.0	744.3	19.8	8.56	5.3	1.6185	2.31	[illegible]
2LTGTU	31/32 TGTU (Scrubber)	325,021	4,627,228	6558.2	2008.1	100.0	30.5	163.0	345.9	45.9	13.98	2.5	0.7620	1.97	0.2163
[illegible]	#1 HDS H1 Heater 25RE001	324,771	4,627,543	6597.9	2011.0	160.0	50.5	605.0	591.8	46.7	14.22	3.1	0.9449	1.90	0.2154
[illegible]	#2 HDS H2 Heater 25RE002	324,771	4,627,574	6597.5	2010.9	100.0	30.5	740.0	665.4	42.5	12.95	3.6	1.0973	1.00	0.1260
[illegible]	#16 Boiler	324,896	4,627,724	6581.4	2006.4	50.0	15.2	500.0	533.2	71.1	21.64	5.0	1.5240	3.04	0.3830
FCCREGEN	FCCU Regenerator Vent	325,033	4,627,365	6590.9	2008.9	[illegible]	40.5	550.0	560.9	52.6	16.03	7.2	2.1935	115.95	14.6096
NAPSPLH	Naphtha Splitter Heater	324,891	4,627,531	6591.5	2009.1	120.0	36.6	310.0	427.6	20.2	6.16	4.0	1.2192	1.85	0.2335
[illegible]	568 #1 20?? Heater	324,831	4,627,350	6581.5	2006.1	90.0	27.4	1370.0	1016.5	24.0	7.31	5.9	1.7998	3.41	0.6691
781LEFH	781 LEF Heater	324,976	4,627,299	6580.0	2005.6	130.0	39.?	675.0	630.4	15.3	4.69	3.0	0.9144	5.03	0.6360
#1REF	781 #1 Reformer Heater	324,837	4,627,330	6598.4	2011.1	150.0	45.7	850.0	727.6	24.2	7.38	5.0	1.5240	1.80	0.2169
#2REF	781 #2 Reformer Heater	324,816	4,627,330	6581.6	2006.1	135.0	41.1	900.0	755.4	29.4	8.95	5.0	1.5240	3.00	0.3780
#3REF	781 #3 Reformer Heater	324,821	4,627,310	6581.5	2006.1	63.0	19.2	1080.0	855.2	9.6	2.92	4.0	1.2192	0.90	0.1134
[illegible]	786 Stabilizer Heater	324,819	4,627,330	6581.3	2006.0	135.0	41.2	685.0	635.9	8.7	2.65	4.0	1.2192	0.49	0.0620
592HF101	592 Pre-Flash Heater, F101	324,854	4,627,328	6590.7	2009.2	120.0	36.6	900.0	755.4	15.0	4.56	4.0	1.2192	0.89	0.1122
[illegible]	591 Pre-Flash Heater, F103	324,810	4,627,328	6591.8	2009.2	120.0	36.6	1100.0	866.5	13.0	3.95	5.0	1.5240	0.67	0.0844
592HE102A	592 Crude Heater, F102A	324,847	4,627,328	6592.8	2009.2	110.0	33.6	930.0	772.0	19.5	5.93	5.0	1.5240	2.51	0.3163
592H102B	592 Crude Heater, F102B	324,850	4,627,398	6591.6	2009.1	120.0	36.6	1040.0	833.2	11.1	3.39	5.0	1.5240	0.60	0.0756
592VH104	592 Vacuum Heater, F104	324,885	4,627,341	6592.9	2009.2	120.0	36.6	770.0	683.2	64.4	19.64	3.0	0.9144	2.57	0.3245
#2HDSHTR	#2 HDS Heater	324,845	4,627,310	6591.4	2009.1	135.0	41.2	300.0	422.0	17.6	5.21	4.0	1.2192	2.89	0.3366
[illegible]	#1 HDS Heater	324,765	4,627,376	6593.9	2009.8	70.0	21.3	820.0	710.9	12.2	3.73	4.0	1.2192	0.70	0.0882
60HPBOIL	60 High Pressure Boiler	324,770	4,627,233	6590.0	2008.6	105.0	32.0	540.0	555.2	42.5	12.96	5.0	1.5240	4.24	0.5342
[illegible]	40 High Pressure Boiler	324,773	4,627,233	6590.0	2008.6	105.0	32.0	500.0	533.2	42.5	12.96	5.0	1.5240	3.34	0.4209
LOCKFLAR	Light Oil Loading Rack Flare	324,532	4,627,354	6593.9	2009.8	35.0	10.7	380.0	465.9	10.3	3.14	6.0	1.8288	0.53	0.0668
[illegible]	Hydrocracker Heater H1/H2	324,787	4,627,450	6595.5	2010.3	120.0	36.6	400.0	477.6	30.5	9.30	3.5	1.0668	1.58	0.1990
[illegible]	Hydrocracker Heater H4	324,782	4,627,455	6595.7	2010.4	145.0	44.0	630.0	605.4	36.4	11.09	4.3	1.3106	7.91	0.9967
#1H2HTR	#1 Hydrogen Plant Heater	324,791	4,627,562	6595.0	2010.4	100.0	30.5	500.0	533.2	90.2	27.44	6.8	2.0604	23.70	2.9862
[illegible]	Hydrocracker Heater H5	324,857	4,627,433	6597.7	2010.1	145.0	44.2	610.0	594.3	22.9	6.98	4.3	1.3106	1.54	0.1940
593VH	593 Vacuum Heater - New Unit	324,885	4,627,291	6593.3	2009.6	122.0	37.2	770.0	683.2	37.6	11.46	4.0	1.2192	2.60	0.3276
[illegible]	Coker Heater	325,101	4,627,250	6584.7	2007.0	175.0	53.3	665.0	597.0	34.6	10.51	6.9	2.1031	5.80	0.7309
COKEFLAR	Coker Flare	325,683	4,627,893	6573.0	2003.5	175.0	53.3	1900.?	1310.9	65.6	20.00	7.8	2.3773	37.00	4.6619
[illegible]	[illegible] transfer pump	329,272	4,626,451	6511.7	1985.5	4.6	1.4	900.0	755.4	1117	340.5	0.4	0.1066	0.59	0.0743
[illegible]	[illegible] Heater	324,604	4,627,569	6565.8	2001.2	100.0	30.5	121.1	322.6	16.9	5.15	5.6	1.7069	2.05	0.2579
CATOX	[illegible]	324,127	4,627,391	6573.3	2003.5	25.0	7.6	650.0	616.5	10.0	3.05	1.2	0.3597	0.08	0.0101
[illegible]	581 heater FIT104	324,869	4,627,223	6589.0	2008.5	100.0	30.5	500.0	533.2	52.5	15.99	5.0	1.5240	9.33	1.1756
[illegible]	#1 TGTU	325,190	4,627,650	6587.9	2008.0	500.0	30.5	620.?	600.2	52.0	15.81	3.0	0.9144	3.51	0.4424
[illegible]	#4 TGTU	324,350	4,627,724	6589.3	2008.4	100.0	30.5	627.4	604.2	58.9	17.95	3.0	0.9144	3.51	0.4428
#2H2HTR	#2 Hydrogen Plant Heater H-401	324,722	4,627,507	6596.3	2010.6	100.0	30.5	540.0	555.2	91.2	28.24	6.8	2.0501	5.76	0.7257
[illegible]	Cummins CFP11E-F20 Pump Engine	325,216	4,624,???	6586.6	2007.6	6.0	1.8	844.0	724.3	390.0	118.87	0.3	0.1016	0.56	0.0706
[illegible]	#11 Boiler	324,771	4,627,270	6590.9	2009.0	50.0	15.2	350.0	449.8	49.2	15.00	5.0	1.5210	3.80	0.4788
[illegible]	#12 Boiler	324,776	4,627,241	6590.3	2008.5	50.0	15.2	500.0	533.2	64.5	19.66	5.0	1.5210	8.50	1.1068
[illegible]	#16 Boiler	324,811	4,627,221	6589.2	2008.4	50.0	15.2	500.0	533.2	34.9	10.65	5.0	1.5210	6.47	0.8152
[illegible]	Backup [illegible] Emergency Generator [illegible]	324,211	4,627,255	6590.9	2008.9	4.6	1.1	975.0	797.0	41.0	13.51	0.3	0.0914	28.70	3.6162
[illegible]	Asphalt Heater #1	325,016	4,627,711	6584.4	2007.1	42.0	12.8	1000.0	810.9	14.2	4.32	3.0	0.9144	0.66	0.0830
[illegible]	#1 Generator	324,811	4,627,214	6589.5	2008.5	30.0	9.1	490.0	527.6	31.8	9.77	5.5	0.8602	7.35	0.9339
[illegible]	740 FCC Heater B3	324,918	4,624,960	6591.4	2009.1	210.0	38.5	650.0	616.5	13.5	4.11	3.0	0.9144	0.81	0.1095
[illegible]	740 FCC Heater H2	324,526	4,627,300	6590.0	2008.6	510.0	155.5	750.0	672.0	41.0	12.51	2.5	0.7590	1.60	0.2016
CG_1	Dresser-Clark [illegible] AS-6	326,818	4,624,655	6503.2	1982.2	35.0	10.7	699.5	643.0	109.0	33.40	1.7	0.5300	6.67	0.8404
CG_2	Dresser-Clark [illegible] AS-6	326,828	4,621,010	6502.9	1982.1	35.0	10.7	659.5	621.0	102.0	31.10	1.7	0.5300	6.67	0.8404
CG_3	Dresser-Clark [illegible] AS-6	326,818	4,624,657	6502.7	1982.0	35.0	10.7	699.5	643.0	102.0	31.10	1.7	0.5300	6.67	0.8404
CG_4	Dresser-Clark [illegible] AS-6	326,814	4,624,609	6502.6	1982.0	35.0	10.7	699.5	643.0	107.0	31.40	1.7	0.5300	8.90	1.1214
CG_5	Dresser-Clark [illegible] AS-6	326,828	4,624,612	6502.5	1982.0	26.0	7.9	699.5	643.0	136.2	41.50	1.7	0.5300	13.73	1.7300
LE_1A	White-Superior 8GT-825	326,857	4,624,586	6503.3	1982.6	18.0	5.5	699.5	643.0	49.0	14.94	1.0	0.3100	0.99	0.1247

APPENDIX D
NAAQS/WAAQS CUMULATIVE MODEL RESULTS

The following attachments are included in this appendix in the following order:

- Table D-1: Cumulative Analysis – 1-hr NO_2 Results
- Table D-2: Cumulative Analysis – Annual NO_2 Results
- Table D-3: Cumulative Analysis – 1-hr SO_2 Results
- Table D-4: Cumulative Analysis – 3-hr SO_2 Results
- Table D-5: Cumulative Analysis – 24-hr SO_2 Results
- Table D-6: Cumulative Analysis – 24-hr $PM_{2.5}$ Results
- Table D-7: Cumulative Analysis – 1-hr CO Results
- Table D-8: Cumulative Analysis – 8-hr CO Results

- Figure D-1: Cumulative Analysis – 1-hr NO_2 Results
- Figure D-2: Cumulative Analysis – Annual NO_2 Results
- Figure D-3: Cumulative Analysis – 1-hr SO_2 Results
- Figure D-4: Cumulative Analysis – 3-hr SO_2 Results
- Figure D-5: Cumulative Analysis – 24-hr SO_2 Results
- Figure D-6: Cumulative Analysis – 24-hr $PM_{2.5}$ Results
- Figure D-7: Cumulative Analysis – 1-hr CO Results
- Figure D-8: Cumulative Analysis – 8-hr CO Results

Table D-1
Cumulative Analysis - 1-hr NO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	ARM(0.8 * Average) (ug/m^3)	ARM+Background (ug/m^3)
327300.00	4626100.00	119.18	145.64	111.76	125.53	100.42	132.52
325000.00	4626400.00	81.92	81.51	196.91	120.12	96.09	128.19
324600.00	4627100.00	93.07	127.57	128.29	116.31	93.05	125.15
327000.00	4626200.00	117.34	127.68	103.74	116.25	93.00	125.10
326900.00	4626200.00	109.45	126.63	101.29	112.46	89.97	122.07
324800.00	4626400.00	73.70	72.56	183.48	109.91	87.93	120.03
324645.40	4627196.40	61.76	128.65	132.95	107.79	86.23	118.33
324674.60	4627195.80	61.45	123.70	133.54	106.23	84.99	117.09
324703.80	4627195.20	69.62	122.02	126.94	106.19	84.95	117.05
324800.00	4626500.00	78.09	70.28	163.52	103.96	83.17	115.27
324500.00	4627000.00	98.06	107.02	104.91	103.33	82.66	114.76
324600.00	4627000.00	94.49	110.41	101.99	103.30	82.64	114.74
324620.20	4627197.40	55.89	128.80	124.54	103.08	82.46	114.56
325092.20	4627184.90	82.67	119.03	106.98	102.89	82.32	114.42
324595.00	4627198.30	60.02	125.67	121.81	102.50	82.00	114.10
324700.00	4626400.00	67.66	65.92	170.32	101.30	81.04	113.14
325100.00	4626500.00	75.72	65.78	160.90	100.80	80.64	112.74
325000.00	4626500.00	77.07	70.63	153.57	100.42	80.34	112.44
324723.80	4627194.90	66.87	121.04	112.70	100.20	80.16	112.26
324700.00	4627100.00	58.17	123.77	117.69	99.88	79.90	112.00
324500.00	4627100.00	65.13	111.03	118.63	98.26	78.61	110.71
324500.00	4626900.00	93.22	101.15	97.87	97.41	77.93	110.03
327100.00	4626200.00	102.25	105.98	83.26	97.16	77.73	109.83
324700.00	4626500.00	71.29	63.14	152.91	95.78	76.63	108.73
324547.40	4627200.70	59.75	117.82	107.63	95.07	76.05	108.15
324400.00	4626800.00	90.00	97.54	93.39	93.64	74.91	107.01
324400.00	4626900.00	92.75	90.20	94.23	92.39	73.91	106.01
324522.20	4627201.40	58.27	112.51	100.82	90.53	72.43	104.53
324400.00	4627000.00	81.93	89.10	99.67	90.23	72.19	104.29
324300.00	4626800.00	83.69	87.54	98.05	89.76	71.81	103.91
324799.60	4627192.60	87.81	85.03	93.72	88.85	71.08	103.18
324400.00	4627100.00	81.60	85.95	96.68	88.08	70.46	102.56
324500.00	4627200.00	58.74	106.16	99.09	88.00	70.40	102.50
324300.00	4626900.00	79.11	87.67	95.19	87.32	69.86	101.96
324497.00	4627202.10	57.52	105.40	96.84	86.59	69.27	101.37
324200.00	4626700.00	86.46	74.39	96.81	85.89	68.71	100.81
324700.00	4627000.00	59.67	98.85	95.35	84.62	67.70	99.80
324100.00	4626600.00	77.57	78.20	93.08	82.95	66.36	98.46
324800.00	4626600.00	72.45	57.94	117.50	82.63	66.10	98.20
324700.00	4626600.00	76.29	62.43	108.24	82.32	65.86	97.96
324461.20	4627202.10	62.97	91.73	89.68	81.46	65.17	97.27
324900.00	4626600.00	71.32	59.40	110.42	80.38	64.30	96.40
324433.30	4627202.20	67.10	87.84	83.87	79.61	63.68	95.78
324900.00	4627100.00	86.07	77.94	74.14	79.38	63.51	95.61
324800.00	4627100.00	50.18	99.37	87.78	79.11	63.29	95.39
325000.00	4626600.00	69.48	59.05	101.38	76.64	61.31	93.41
324700.00	4626900.00	59.63	88.03	81.26	76.31	61.05	93.15
324405.30	4627202.30	64.51	80.68	79.12	74.77	59.81	91.91
324400.00	4627200.00	65.41	80.23	78.55	74.73	59.78	91.88
324763.20	4627193.50	47.84	92.06	83.91	74.60	59.68	91.78
325100.00	4626600.00	66.17	56.45	100.54	74.39	59.51	91.61
324900.00	4627000.00	80.47	68.52	74.08	74.35	59.48	91.58
325282.40	4627182.60	77.69	71.80	72.66	74.05	59.24	91.34
325233.40	4627179.90	74.60	72.29	73.93	73.61	58.88	90.98
325280.80	4627176.10	74.80	72.00	73.45	73.42	58.73	90.83
325117.60	4627184.10	70.18	76.03	71.72	72.64	58.11	90.21
324800.00	4627000.00	50.60	85.02	81.73	72.45	57.96	90.06
325200.10	4627179.90	71.93	70.42	74.42	72.26	57.81	89.91
325158.90	4627182.00	69.63	73.29	72.89	71.94	57.55	89.65
324700.00	4626700.00	67.57	66.85	77.80	70.74	56.59	88.69
329276.30	4627614.00	71.55	65.67	68.56	68.59	54.88	86.98
325019.50	4627186.50	65.61	70.04	68.68	68.11	54.48	86.58
324700.00	4626800.00	64.64	71.14	67.71	67.83	54.26	86.36
324972.20	4627187.20	64.95	71.04	67.33	67.77	54.22	86.32
324929.70	4627188.10	63.40	69.66	68.69	67.25	53.80	85.90
325000.00	4626900.00	65.91	61.33	69.58	65.61	52.49	84.59
324836.00	4627191.70	48.01	77.21	69.82	65.01	52.01	84.11
324406.00	4627302.60	73.03	57.18	64.75	64.99	51.99	84.09
329467.00	4627683.90	72.97	58.34	63.35	64.89	51.91	84.01

Table D-1
Cumulative Analysis - 1-hr NO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	ARM(0.8 * Average) (ug/m^3)	ARM+Background (ug/m^3)
324400.00	4627300.00	71.90	56.82	64.57	64.43	51.54	83.64
324800.00	4626700.00	61.59	56.45	73.73	63.92	51.14	83.24
324904.20	4627189.10	59.26	65.88	65.47	63.54	50.83	82.93
324405.40	4627236.80	53.26	65.60	71.69	63.52	50.81	82.91
324803.60	4627803.10	68.95	58.15	62.35	63.15	50.52	82.62
324878.80	4627190.20	55.92	70.32	61.79	62.68	50.14	82.24
324900.00	4626700.00	56.96	57.84	72.91	62.57	50.06	82.16
329085.50	4627624.10	62.16	56.64	67.72	62.17	49.74	81.84
325100.00	4626700.00	63.32	53.98	68.12	61.81	49.45	81.55
325000.00	4626700.00	61.81	56.42	65.97	61.40	49.12	81.22
329037.80	4627626.60	56.83	61.87	65.09	61.26	49.01	81.11
324800.00	4626900.00	46.12	67.88	69.24	61.08	48.87	80.97
324300.00	4627800.00	55.66	60.06	66.54	60.75	48.60	80.70
324900.00	4626900.00	54.84	63.22	61.77	60.61	48.49	80.59
325000.00	4626800.00	59.17	60.16	57.38	58.90	47.12	79.22
324800.00	4626800.00	54.30	61.06	59.06	58.14	46.51	78.61
324900.00	4626800.00	55.05	60.43	57.49	57.66	46.13	78.23
329123.40	4629208.80	62.45	47.79	51.18	53.81	43.04	75.14
329611.50	4629200.30	58.78	44.87	49.38	50.99	40.80	72.90
329658.60	4629198.10	55.76	43.70	48.98	49.48	39.58	71.68
329700.00	4629300.00	56.33	41.81	48.17	48.77	39.02	71.12
329800.00	4629500.00	58.50	39.61	45.77	47.96	38.37	70.47
329900.00	4629600.00	62.77	38.28	41.92	47.66	38.12	70.22
329900.00	4629700.00	60.13	37.18	42.34	46.55	37.24	69.34
330000.00	4629800.00	59.54	38.68	40.80	46.34	37.07	69.17

[E] Eighth Highest Maximum Daily 1-hr Value.

Table D-2
Cumulative Analysis - Annual NO_2 Results

Year	UTM(E)	UTM(N)	Concentration[1]	ARM(0.75 * Average)	ARM+Background
	(m)	(m)	(ug/m^3)	(ug/m^3)	(ug/m^3)
2008	325158.90	4627182.00	8.29	6.22	11.92
2009	325158.90	4627182.00	13.30	9.97	15.67
2010	325158.90	4627182.00	10.97	8.23	13.93

[1] Maximum Annual Average.

Table D-3
Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ng/m^3)
321250.00	4630750.00	56.92	105.16	87.40	81.16	101.96
321000.00	4630250.00	53.93	80.33	93.27	75.84	96.64
321500.00	4629750.00	54.09	63.62	86.17	67.96	88.76
322000.00	4631250.00	49.00	76.47	69.63	65.03	85.83
321000.00	4629500.00	58.55	59.09	73.64	63.76	84.56
321250.00	4630500.00	51.76	55.85	79.31	62.30	83.10
324703.80	4627195.20	51.08	63.80	64.29	59.72	80.52
320500.00	4631000.00	51.66	46.53	77.61	58.60	79.40
324674.60	4627195.80	52.17	59.90	62.35	58.14	78.94
324700.00	4627100.00	49.69	64.25	58.10	57.35	78.15
324600.00	4627100.00	47.66	58.34	62.94	56.32	77.12
324600.00	4627000.00	54.40	57.51	54.89	55.60	76.40
321500.00	4630250.00	57.67	45.84	60.89	54.80	75.60
324500.00	4627000.00	53.51	53.72	57.00	54.75	75.55
324400.00	4626900.00	50.90	56.40	55.27	54.19	74.99
324723.80	4627194.90	42.77	56.28	61.31	53.46	74.26
324645.40	4627196.40	36.85	61.61	61.90	53.45	74.25
324500.00	4626900.00	49.64	54.87	54.66	53.06	73.86
321500.00	4629500.00	48.96	54.83	54.82	52.87	73.67
324500.00	4627100.00	47.31	52.22	58.91	52.81	73.61
321250.00	4630250.00	53.93	45.64	55.94	51.84	72.64
329500.00	4622000.00	38.23	46.91	68.95	51.36	72.16
324620.20	4627197.40	34.46	61.18	58.20	51.28	72.08
324300.00	4627000.00	47.59	49.15	56.17	50.97	71.77
321750.00	4630000.00	50.48	44.91	54.69	50.03	70.83
324700.00	4627000.00	47.95	52.56	48.83	49.78	70.58
320500.00	4630500.00	54.50	46.48	48.26	49.75	70.55
324600.00	4626900.00	49.13	50.15	49.28	49.52	70.32
321750.00	4630250.00	52.63	42.98	52.38	49.33	70.13
321500.00	4630750.00	51.17	42.53	53.72	49.14	69.94
324595.60	4627198.30	35.40	57.52	54.18	49.03	69.83
324400.00	4627000.00	39.75	47.93	56.44	48.04	68.84
324300.00	4626800.00	44.34	47.89	51.28	47.84	68.64
324400.00	4627100.00	48.99	40.46	52.25	47.23	68.03
321750.00	4629750.00	45.84	47.27	48.00	47.04	67.84
324547.40	4627200.70	33.24	52.76	53.28	46.42	67.22
324763.20	4627193.50	32.25	49.48	57.01	46.24	67.04
324300.00	4626900.00	40.60	45.89	51.89	46.12	66.92
324800.00	4627100.00	36.54	53.30	48.08	45.98	66.78
324522.20	4627201.40	34.39	48.60	53.34	45.44	66.24
321500.00	4630500.00	48.21	41.87	46.18	45.42	66.22
324799.60	4627192.60	37.52	44.55	52.54	44.87	65.67
325560.00	4627320.00	43.92	43.93	46.17	44.67	65.47
324200.00	4626800.00	40.02	44.76	48.41	44.40	65.20
324700.00	4627000.00	42.77	40.53	49.52	44.27	65.07
324500.00	4627200.00	34.75	46.35	50.91	44.00	64.80
324200.00	4626700.00	40.32	44.00	47.49	43.94	64.74
324200.00	4626900.00	39.41	43.90	48.39	43.90	64.70
325563.20	4627342.60	42.31	43.73	45.32	43.79	64.59
322000.00	4630000.00	44.09	44.47	42.74	43.77	64.57
324700.00	4626900.00	44.20	43.64	43.12	43.65	64.45
324497.00	4627202.10	34.24	45.53	50.41	43.39	64.19
324900.00	4627100.00	30.31	49.04	50.51	43.29	64.09
325612.60	4627343.50	41.88	42.91	44.66	43.15	63.95
325315.50	4627181.00	44.17	39.41	45.23	42.94	63.74
324100.00	4626900.00	40.33	41.61	46.76	42.90	63.70
325282.40	4627182.60	43.07	41.32	44.23	42.87	63.67
325343.20	4627180.70	42.81	40.45	45.18	42.81	63.61
325370.90	4627180.40	42.26	40.66	44.50	42.47	63.27
324800.00	4627000.00	38.84	44.02	44.08	42.31	63.11
325280.80	4627176.10	42.35	39.59	44.81	42.25	63.05
324836.00	4627191.70	35.97	40.14	50.32	42.14	62.94

Table D-3
Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m[3])	2009 Concentration[1] (ug/m[3])	2010 Concentration[1] (ug/m[3])	3-yr Average (ug/m[3])	3-yr Average + Background (ug/m[3])
324904.20	4627189.10	34.18	40.42	51.60	42.07	62.87
324500.00	4625750.00	48.89	33.52	43.48	41.96	62.76
325233.40	4627179.90	40.95	41.53	42.95	41.81	62.61
325401.90	4627180.20	40.74	41.18	43.42	41.78	62.58
325560.00	4627278.50	40.89	39.93	44.42	41.75	62.55
325092.20	4627184.90	36.42	44.64	44.11	41.72	62.52
325117.60	4627184.10	38.94	43.56	42.64	41.71	62.51
325600.00	4627300.00	40.99	39.41	44.65	41.69	62.49
324100.00	4626700.00	39.36	40.95	44.44	41.58	62.38
325662.10	4627344.30	40.52	40.64	43.13	41.43	62.23
324878.80	4627190.20	35.15	39.68	49.23	41.35	62.15
325000.00	4627100.00	30.23	46.53	46.27	41.01	61.81
324929.70	4627188.10	31.71	40.35	50.33	40.80	61.60
325432.80	4627179.90	39.35	40.84	42.04	40.74	61.54
324461.20	4627202.10	33.30	41.60	46.05	40.32	61.12
325158.90	4627182.00	37.52	42.83	40.37	40.24	61.04
325200.10	4627179.90	38.06	42.36	39.89	40.10	60.90
327000.00	4622000.00	38.38	30.96	50.68	40.00	60.80
324100.00	4626800.00	36.87	38.89	43.47	39.74	60.54
325711.60	4627345.20	39.42	38.76	41.01	39.73	60.53
324000.00	4626900.00	37.78	38.08	43.17	39.68	60.48
324300.00	4627100.00	43.24	34.95	40.69	39.63	60.43
324700.00	4626800.00	39.41	39.01	40.18	39.53	60.33
325479.00	4627179.90	37.57	39.29	40.39	39.09	59.89
325700.00	4627300.00	38.27	36.68	41.22	38.73	59.53
325560.00	4627237.10	39.84	38.16	37.90	38.63	59.43
325066.80	4627185.80	33.05	42.15	40.22	38.47	59.27
324100.00	4627000.00	40.67	34.57	40.05	38.43	59.23
324433.30	4627202.20	32.96	39.04	42.95	38.31	59.11
325761.00	4627346.00	37.95	37.53	39.40	38.29	59.09
324750.00	4625750.00	39.83	33.04	41.49	38.12	58.92
325514.80	4627182.10	36.48	37.96	39.32	37.92	58.72
325100.00	4627100.00	36.80	37.51	39.26	37.86	58.66
324800.00	4626900.00	36.62	36.03	40.63	37.76	58.56
325300.00	4627100.00	37.13	36.99	39.05	37.72	58.52
325810.50	4627346.90	37.38	36.77	39.03	37.72	58.52
325400.00	4627100.00	37.42	36.99	38.37	37.59	58.39
324000.00	4626800.00	36.21	35.61	40.37	37.40	58.20
325560.00	4627195.70	38.36	35.47	37.97	37.27	58.07
324405.30	4627202.30	32.11	36.85	42.27	37.07	57.87
325546.30	4627183.70	35.63	36.86	38.63	37.04	57.84
325200.00	4627100.00	36.80	37.44	36.72	36.99	57.79
324400.00	4627200.00	32.47	36.70	41.77	36.98	57.78
325860.00	4627347.70	36.69	35.39	38.12	36.73	57.53
324700.00	4626700.00	34.61	35.68	39.73	36.67	57.47
324900.00	4627000.00	29.06	39.40	41.45	36.63	57.43
325000.00	4625750.00	39.16	32.10	38.61	36.62	57.42
325500.00	4627100.00	35.82	35.18	38.53	36.51	57.31
325600.00	4627200.00	37.54	34.46	37.51	36.50	57.30
324200.00	4627100.00	34.83	32.36	41.44	36.21	57.01
325300.00	4627000.00	36.75	33.70	36.82	35.76	56.56
323900.00	4626800.00	32.49	35.20	39.57	35.76	56.56
325250.00	4625750.00	38.77	30.88	37.43	35.69	56.49
325800.00	4627300.00	35.41	34.27	37.33	35.67	56.47
325909.40	4627348.60	35.95	33.73	37.26	35.65	56.45
324800.00	4626200.00	35.54	28.26	42.52	35.44	56.24
324500.00	4625500.00	38.76	31.32	35.88	35.32	56.12
325200.00	4627000.00	35.48	32.90	36.74	35.04	55.84
325600.00	4627100.00	35.35	32.49	37.24	35.03	55.83
323900.00	4626900.00	35.66	31.61	37.81	35.03	55.83
324900.00	4626200.00	34.80	29.19	40.55	34.85	55.65
324100.00	4627100.00	33.92	29.48	41.04	34.82	55.62

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
324750.00	4625500.00	38.65	30.81	34.88	34.78	55.58
322750.00	4627250.00	36.13	30.13	37.94	34.73	55.53
324800.00	4626800.00	32.63	32.53	38.87	34.68	55.48
325958.90	4627349.40	34.20	32.88	36.31	34.46	55.26
325700.00	4627200.00	34.68	32.00	36.58	34.42	55.22
324700.00	4626200.00	34.60	26.23	42.27	34.36	55.16
324000.00	4627000.00	33.90	31.73	37.31	34.31	55.11
324700.00	4626100.00	33.01	27.04	42.72	34.26	55.06
325250.00	4625500.00	35.02	32.91	34.73	34.22	55.02
324405.50	4627271.20	32.56	33.39	36.45	34.13	54.93
325000.00	4627000.00	28.99	34.89	38.43	34.10	54.90
325400.00	4627000.00	35.26	31.08	35.94	34.09	54.89
324800.00	4626100.00	33.09	26.81	42.36	34.09	54.89
325900.00	4627300.00	33.68	33.11	35.24	34.01	54.81
324900.00	4626300.00	31.58	30.13	40.28	34.00	54.80
324750.00	4626000.00	33.49	26.90	41.46	33.95	54.75
325600.00	4627000.00	35.30	31.50	35.01	33.94	54.74
324900.00	4626400.00	32.47	31.08	38.13	33.89	54.69
324600.00	4626200.00	34.02	27.72	39.88	33.87	54.67
323100.00	4627400.00	33.84	33.73	34.01	33.86	54.66
325500.00	4627000.00	36.44	28.94	36.19	33.86	54.66
323800.00	4626800.00	32.36	33.36	35.76	33.83	54.63
324406.00	4627302.60	36.54	29.69	35.24	33.83	54.63
325000.00	4625500.00	36.21	31.71	33.53	33.82	54.62
324600.00	4626100.00	33.04	27.31	40.97	33.77	54.57
324972.20	4627187.20	27.70	36.31	37.25	33.75	54.55
325500.00	4625750.00	37.86	29.49	33.87	33.74	54.54
325300.00	4626900.00	32.84	33.26	35.10	33.73	54.53
326008.30	4627350.30	33.00	31.70	36.48	33.72	54.52
324400.00	4627300.00	35.86	29.70	35.28	33.61	54.41
325300.00	4626800.00	33.71	32.50	34.62	33.61	54.41
324385.20	4627335.10	36.11	29.95	34.74	33.60	54.40
324395.30	4627334.30	36.36	29.89	34.52	33.59	54.39
324900.00	4626100.00	34.41	28.28	38.05	33.58	54.38
325000.00	4626400.00	31.23	32.91	36.57	33.57	54.37
324406.60	4627334.00	36.60	29.82	34.10	33.51	54.31
324800.00	4626300.00	31.73	27.96	40.82	33.51	54.31
324500.00	4628800.00	31.24	34.26	34.55	33.35	54.15
324341.90	4627336.40	34.74	30.20	35.11	33.35	54.15
326000.00	4627300.00	33.26	31.28	35.44	33.33	54.13
325000.00	4626200.00	34.12	31.13	34.30	33.19	53.99
324600.00	4626500.00	30.95	32.69	35.90	33.18	53.98
324700.00	4626400.00	30.75	31.77	36.99	33.17	53.97
323000.00	4627000.00	32.52	30.51	36.37	33.14	53.94
323100.00	4627300.00	34.51	28.38	36.42	33.10	53.90
323000.00	4627250.00	34.86	27.62	36.81	33.10	53.90
323200.00	4627400.00	33.70	32.20	33.29	33.06	53.86
325700.00	4627100.00	33.10	30.45	35.61	33.05	53.85
326057.80	4627351.10	32.42	30.62	36.12	33.05	53.85
324700.00	4626600.00	30.32	30.85	37.94	33.04	53.84
325019.50	4627186.50	30.36	31.40	37.25	33.00	53.80
323800.00	4626900.00	32.12	31.40	35.48	33.00	53.80
325800.00	4627200.00	33.83	30.38	34.76	32.99	53.79
324600.00	4626400.00	32.03	30.24	36.67	32.98	53.78
324800.00	4626700.00	27.33	32.76	38.84	32.98	53.78
324900.00	4626900.00	28.87	32.05	37.93	32.95	53.75
325100.00	4626900.00	34.27	30.21	34.36	32.95	53.75
325000.00	4626300.00	30.44	32.05	36.35	32.95	53.75
325200.00	4626900.00	31.19	32.20	35.39	32.93	53.73
324500.00	4626400.00	32.01	32.08	34.65	32.92	53.72
324307.30	4627338.40	33.44	30.41	34.89	32.91	53.71
324900.00	4626700.00	27.20	33.46	38.00	32.89	53.69

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m³)	2009 Concentration[1] (ug/m³)	2010 Concentration[1] (ug/m³)	3-yr Average (ug/m³)	3-yr Average + Background (ug/m³)
324300.00	4627200.00	30.88	30.30	37.43	32.87	53.67
324700.00	4626300.00	30.45	28.21	39.95	32.87	53.67
325600.00	4628100.00	32.36	32.82	33.35	32.85	53.65
324400.00	4628800.00	31.12	34.03	33.32	32.82	53.62
323300.00	4626900.00	33.23	29.19	35.98	32.80	53.60
324500.00	4624250.00	35.47	31.19	31.71	32.79	53.59
325032.50	4627799.80	33.86	31.05	33.37	32.76	53.56
324600.00	4626300.00	31.11	28.84	38.26	32.74	53.54
323300.00	4627400.00	33.48	30.42	34.23	32.71	53.51
323400.00	4627500.00	32.27	32.54	33.30	32.70	53.50
325250.00	4626000.00	36.93	26.95	34.21	32.70	53.50
323400.00	4626900.00	33.01	29.19	35.79	32.66	53.46
323500.00	4627500.00	32.38	32.68	32.91	32.66	53.46
325700.00	4627000.00	31.88	30.51	35.52	32.63	53.43
323700.00	4626800.00	30.65	32.40	34.85	32.63	53.43
323300.00	4627500.00	32.09	32.34	33.38	32.60	53.40
325000.00	4626000.00	34.85	29.31	33.61	32.59	53.39
323500.00	4626900.00	32.77	29.34	35.58	32.56	53.36
325576.80	4628082.20	32.29	32.44	32.93	32.56	53.36
323200.00	4627500.00	32.50	32.29	32.85	32.55	53.35
324600.00	4628800.00	30.20	34.36	33.02	32.52	53.32
323100.00	4627200.00	33.62	28.22	35.62	32.49	53.29
323700.00	4626900.00	32.23	30.12	35.11	32.49	53.29
323200.00	4627300.00	34.01	27.48	35.89	32.47	53.27
323600.00	4626900.00	32.51	29.42	35.35	32.43	53.23
324900.00	4626800.00	28.44	32.13	36.69	32.42	53.22
323400.00	4627400.00	33.34	28.81	35.09	32.41	53.21
323900.00	4627000.00	33.07	29.15	34.99	32.40	53.20
325000.00	4625250.00	31.10	31.48	34.62	32.40	53.20
324000.00	4628300.00	29.30	36.69	31.21	32.40	53.20
324700.00	4626500.00	29.49	31.50	36.20	32.40	53.20
326107.30	4627352.00	31.86	29.57	35.76	32.40	53.20
324400.00	4628700.00	30.12	35.26	31.69	32.36	53.16
324405.40	4627236.80	30.36	31.16	35.38	32.30	53.10
324400.00	4626200.00	34.73	28.81	33.34	32.29	53.09
323600.00	4626700.00	32.26	33.26	31.30	32.27	53.07
324000.00	4627100.00	31.67	29.14	36.01	32.27	53.07
325400.00	4626800.00	31.31	32.57	32.88	32.25	53.05
324800.00	4626400.00	31.74	27.17	37.77	32.23	53.03
324800.00	4628900.00	29.91	33.34	33.43	32.23	53.03
325100.00	4626200.00	33.53	30.68	32.43	32.21	53.01
323500.00	4627000.00	32.73	28.60	35.14	32.15	52.95
324700.00	4628900.00	30.91	33.17	32.35	32.14	52.94
324300.00	4628800.00	30.75	33.68	31.96	32.13	52.93
324250.00	4624750.00	35.08	32.17	29.12	32.13	52.93
323600.00	4627500.00	32.39	31.63	32.36	32.12	52.92
325056.00	4627835.80	33.58	30.76	31.99	32.11	52.91
324750.00	4625250.00	27.65	31.25	37.43	32.11	52.91
323200.00	4627200.00	32.87	27.88	35.51	32.09	52.89
323500.00	4627400.00	33.20	28.01	34.95	32.05	52.85
325200.00	4626800.00	33.58	30.35	32.22	32.05	52.85
325100.00	4627000.00	31.59	31.88	32.62	32.03	52.83
324500.00	4626200.00	34.60	28.18	33.16	31.98	52.78
324500.00	4626000.00	32.35	28.27	35.29	31.97	52.77
323600.00	4627000.00	32.63	28.25	35.03	31.97	52.77
325800.00	4627100.00	31.75	28.77	35.37	31.96	52.76
324166.40	4627422.50	32.01	30.45	33.39	31.95	52.75
324141.70	4627446.40	31.12	30.90	33.79	31.94	52.74
325400.00	4626900.00	32.55	29.17	34.08	31.93	52.73
325000.00	4626900.00	28.66	29.57	37.53	31.92	52.72
325900.00	4627200.00	32.77	28.44	34.49	31.90	52.70
324191.20	4627398.70	31.25	29.96	34.48	31.90	52.70

Table D-3
Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
323900.00	4627100.00	31.68	28.31	35.69	31.89	52.69
325000.00	4626100.00	33.08	30.22	32.38	31.89	52.69
323100.00	4627100.00	33.17	28.78	33.63	31.86	52.66
326100.00	4627300.00	31.47	29.45	34.58	31.83	52.63
323800.00	4627000.00	31.91	28.02	35.56	31.83	52.63
324200.00	4629100.00	33.10	31.33	31.06	31.83	52.63
325100.00	4626400.00	31.23	31.48	32.74	31.81	52.61
323300.00	4627300.00	33.51	26.62	35.31	31.81	52.61
324300.00	4627300.00	31.51	29.77	34.13	31.81	52.61
324300.00	4629000.00	31.09	33.46	30.86	31.80	52.60
326156.70	4627352.80	30.76	29.17	35.40	31.78	52.58
324100.00	4627400.00	31.66	30.63	32.91	31.73	52.53
324500.00	4626100.00	32.93	28.42	33.82	31.72	52.52
324500.00	4628600.00	29.30	34.98	30.82	31.70	52.50
323600.00	4627100.00	31.50	28.86	34.68	31.68	52.48
324986.70	4627800.50	32.56	30.76	31.70	31.67	52.47
324400.00	4628900.00	30.89	33.65	30.45	31.66	52.46
323600.00	4627400.00	32.99	27.21	34.74	31.65	52.45
323700.00	4627000.00	32.14	27.91	34.90	31.65	52.45
323200.00	4627100.00	32.57	28.69	33.59	31.62	52.42
325100.00	4626100.00	32.96	29.91	31.92	31.60	52.40
324600.00	4628600.00	29.62	34.41	30.75	31.60	52.40
324200.00	4629000.00	32.01	31.84	30.90	31.58	52.38
324500.00	4626300.00	30.35	29.81	34.53	31.56	52.36
323900.00	4627600.00	30.86	31.62	32.15	31.54	52.34
324600.00	4628900.00	30.65	32.86	31.09	31.53	52.33
323700.00	4627100.00	31.61	28.41	34.55	31.53	52.33
324266.80	4627339.70	31.20	29.00	34.30	31.50	52.30
323600.00	4627700.00	30.84	32.05	31.61	31.50	52.30
323700.00	4627500.00	32.33	29.99	32.16	31.49	52.29
324800.00	4626600.00	26.68	33.48	34.32	31.49	52.29
324600.00	4628700.00	29.92	34.89	29.65	31.49	52.29
323800.00	4627600.00	30.88	31.49	32.09	31.48	52.28
320000.00	4631500.00	27.13	29.62	37.68	31.48	52.28
323400.00	4627300.00	33.02	26.64	34.75	31.47	52.27
323800.00	4627100.00	31.65	28.51	34.19	31.45	52.25
325079.50	4627871.90	32.51	30.36	31.46	31.44	52.24
325100.00	4626300.00	30.42	31.17	32.72	31.44	52.24
324200.00	4627200.00	31.34	29.68	33.27	31.43	52.23
323300.00	4627200.00	32.09	26.82	35.38	31.43	52.23
324500.00	4628700.00	29.28	35.14	29.86	31.42	52.22
323300.00	4627100.00	31.96	28.59	33.71	31.42	52.22
324900.00	4628900.00	28.80	33.39	32.06	31.42	52.22
325000.00	4626800.00	28.08	29.91	36.19	31.39	52.19
324700.00	4628800.00	28.98	34.33	30.86	31.39	52.19
324000.00	4628200.00	30.38	33.99	29.80	31.39	52.19
324656.50	4627726.50	32.84	29.84	31.48	31.39	52.19
325500.00	4625500.00	33.45	28.69	31.96	31.37	52.17
323500.00	4627100.00	31.31	28.60	34.15	31.35	52.15
323700.00	4627600.00	30.95	31.30	31.79	31.35	52.15
325500.00	4626900.00	32.20	31.10	30.65	31.32	52.12
324706.10	4627726.80	30.14	30.40	33.35	31.30	52.10
324122.30	4627465.70	30.86	29.03	34.00	31.30	52.10
324500.00	4628900.00	30.69	33.10	30.09	31.30	52.10
324253.20	4627340.50	31.22	28.61	34.04	31.29	52.09
324000.00	4627600.00	30.77	30.94	32.11	31.27	52.07
324103.00	4627485.00	31.05	28.61	34.10	31.25	52.05
324200.00	4629300.00	33.95	29.24	30.54	31.25	52.05
323500.00	4627300.00	32.63	26.76	34.34	31.24	52.04
324300.00	4629100.00	32.16	31.11	30.45	31.24	52.04
323400.00	4627100.00	31.36	28.53	33.80	31.23	52.03
324300.00	4628900.00	30.56	34.08	29.03	31.22	52.02

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m³)	2009 Concentration[1] (ug/m³)	2010 Concentration[1] (ug/m³)	3-yr Average (ug/m³)	3-yr Average + Background (ug/m³)
324400.00	4629000.00	30.29	33.40	29.88	31.19	51.99
324700.00	4628700.00	29.37	34.52	29.68	31.19	51.99
323800.00	4627500.00	32.17	28.39	33.01	31.19	51.99
323800.00	4627400.00	32.20	27.50	33.86	31.19	51.99
324000.00	4627400.00	31.01	29.47	33.01	31.16	51.96
323700.00	4627400.00	32.66	26.39	34.38	31.14	51.94
323600.00	4627300.00	32.23	26.89	34.29	31.13	51.93
324400.00	4626100.00	33.03	27.83	32.53	31.13	51.93
323400.00	4627200.00	31.75	26.69	34.94	31.13	51.93
324300.00	4629300.00	33.74	29.16	30.47	31.12	51.92
325800.00	4627000.00	29.86	28.32	35.16	31.11	51.91
325100.00	4629000.00	28.58	32.42	32.33	31.11	51.91
324000.00	4628100.00	30.49	33.08	29.70	31.09	51.89
325000.00	4626500.00	27.49	33.54	32.24	31.09	51.89
324100.00	4629300.00	33.64	29.47	30.14	31.08	51.88
324200.00	4629200.00	33.41	28.90	30.87	31.06	51.86
324222.20	4627369.60	30.85	29.31	32.97	31.04	51.84
324600.00	4628500.00	28.09	34.36	30.58	31.01	51.81
325000.00	4629000.00	29.47	32.26	31.29	31.01	51.81
323900.00	4627400.00	31.62	28.17	33.22	31.00	51.80
323500.00	4627200.00	32.21	26.95	33.79	30.98	51.78
324200.00	4627300.00	31.34	28.31	33.30	30.98	51.78
323900.00	4627500.00	31.86	27.60	33.46	30.97	51.77
324100.00	4627500.00	31.10	27.65	34.16	30.97	51.77
324500.00	4628500.00	28.18	33.84	30.89	30.97	51.77
325400.00	4626700.00	32.42	28.67	31.81	30.96	51.76
325230.00	4628028.00	30.65	31.66	30.57	30.96	51.76
324500.00	4625250.00	27.25	30.35	35.20	30.93	51.73
324300.00	4629200.00	32.42	29.58	30.80	30.93	51.73
324607.00	4627726.20	32.59	30.01	30.17	30.92	51.72
324106.70	4627638.60	30.13	31.24	31.37	30.91	51.71
323700.00	4627700.00	29.60	31.77	31.35	30.91	51.71
323700.00	4627300.00	31.64	26.86	34.20	30.90	51.70
326206.20	4627353.70	29.65	28.09	34.96	30.90	51.70
324400.00	4629100.00	31.29	30.81	30.54	30.88	51.68
324700.00	4628600.00	28.39	33.74	30.51	30.88	51.68
324500.00	4629100.00	30.55	31.64	30.35	30.85	51.65
324800.00	4628700.00	28.52	34.06	29.92	30.83	51.63
324900.00	4628700.00	28.93	33.50	30.05	30.83	51.63
324100.00	4627200.00	30.22	29.76	32.48	30.82	51.62
324000.00	4627500.00	31.48	27.29	33.66	30.81	51.61
323800.00	4627700.00	29.81	31.42	31.15	30.79	51.59
324900.00	4629000.00	30.27	31.99	30.12	30.79	51.59
324940.90	4627801.10	31.17	29.46	31.71	30.78	51.58
325900.00	4627100.00	29.80	27.43	35.11	30.78	51.58
324700.00	4629000.00	30.32	32.38	29.61	30.77	51.57
325200.00	4626100.00	33.54	26.85	31.89	30.76	51.56
325200.00	4626200.00	32.85	27.28	32.13	30.76	51.56
325100.00	4626800.00	30.76	27.73	33.74	30.74	51.54
324900.00	4626500.00	27.90	31.69	32.58	30.72	51.52
325700.00	4626900.00	32.31	25.36	34.49	30.72	51.52
324300.00	4629400.00	33.30	28.95	29.91	30.72	51.52
324500.00	4628400.00	28.47	33.59	30.08	30.71	51.51
324400.00	4629200.00	31.89	29.92	30.33	30.71	51.51
327250.00	4625750.00	36.26	25.14	30.72	30.71	51.51
323600.00	4627200.00	31.95	27.41	32.73	30.69	51.49
325150.00	4627980.00	30.70	30.84	30.53	30.69	51.49
323900.00	4627700.00	29.99	31.03	31.03	30.68	51.48
324100.00	4627600.00	30.62	29.37	32.00	30.67	51.47
324100.00	4628200.00	30.03	32.72	29.19	30.65	51.45
325103.00	4627907.90	31.57	29.60	30.76	30.64	51.44
325800.00	4626900.00	32.35	25.52	34.04	30.63	51.43

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
324105.70	4627599.20	30.62	29.24	32.01	30.62	51.42
324600.00	4627900.00	30.74	30.09	31.03	30.62	51.42
324500.00	4629400.00	33.10	28.45	30.29	30.61	51.41
325600.00	4626900.00	30.98	28.90	31.94	30.60	51.40
324103.90	4627523.10	31.09	26.61	34.10	30.60	51.40
323800.00	4627300.00	30.94	26.74	34.07	30.58	51.38
324900.00	4628800.00	28.96	33.92	28.86	30.58	51.38
324600.00	4629100.00	30.00	32.29	29.44	30.58	51.38
324517.30	4627727.90	30.42	30.32	30.99	30.57	51.37
324400.00	4629300.00	33.02	28.48	30.20	30.57	51.37
324562.10	4627727.00	31.68	30.18	29.77	30.54	51.34
324000.00	4627200.00	30.94	28.22	32.45	30.54	51.34
324500.00	4629000.00	29.87	33.22	28.48	30.53	51.33
325000.00	4628800.00	28.71	33.55	29.21	30.49	51.29
325000.00	4626700.00	26.98	30.39	34.09	30.49	51.29
324200.00	4629400.00	33.28	28.48	29.71	30.49	51.29
323700.00	4627200.00	31.42	27.84	32.20	30.49	51.29
324400.00	4629400.00	33.27	28.77	29.43	30.49	51.29
324800.00	4626500.00	28.27	29.07	34.11	30.48	51.28
324800.00	4629000.00	30.09	31.71	29.64	30.48	51.28
324800.00	4628800.00	28.37	34.17	28.88	30.48	51.28
323900.00	4627200.00	30.28	28.70	32.39	30.46	51.26
325200.00	4629000.00	27.61	32.49	31.15	30.41	51.21
324100.00	4628100.00	29.79	32.67	28.76	30.41	51.21
324600.00	4629000.00	30.04	32.88	28.29	30.40	51.20
326000.00	4627200.00	30.60	26.35	34.25	30.40	51.20
324600.00	4629200.00	30.71	30.33	30.15	30.40	51.20
325000.00	4627900.00	31.11	29.27	30.76	30.38	51.18
324500.00	4629200.00	31.33	29.78	30.02	30.38	51.18
325000.00	4628700.00	28.23	32.86	30.01	30.37	51.17
324700.00	4628500.00	27.70	33.16	30.24	30.37	51.17
324200.00	4628200.00	29.60	32.58	28.84	30.34	51.14
324100.00	4629400.00	33.11	28.64	29.22	30.32	51.12
325400.00	4628900.00	27.63	33.35	29.98	30.32	51.12
324104.80	4627561.20	30.94	27.55	32.42	30.30	51.10
324000.00	4627700.00	30.08	30.58	30.23	30.30	51.10
325200.00	4626400.00	31.19	27.91	31.66	30.26	51.06
324895.20	4627801.80	30.72	28.16	31.89	30.25	51.05
324750.00	4625000.00	24.05	30.21	36.50	30.25	51.05
323800.00	4627200.00	30.85	27.59	32.31	30.25	51.05
325100.00	4626500.00	27.25	31.38	32.11	30.24	51.04
324700.00	4627800.00	29.92	29.95	30.83	30.23	51.03
324600.00	4627800.00	31.28	30.47	28.92	30.23	51.03
323900.00	4627300.00	30.24	26.55	33.88	30.22	51.02
325900.00	4627000.00	28.33	27.53	34.80	30.22	51.02
324107.60	4627677.90	29.48	30.61	30.54	30.21	51.01
324472.40	4627728.70	29.75	30.54	30.34	30.21	51.01
324600.00	4628400.00	28.57	32.47	29.53	30.19	50.99
325000.00	4626600.00	25.57	32.79	32.10	30.15	50.95
325100.00	4628800.00	27.88	33.11	29.45	30.15	50.95
324500.00	4629300.00	31.89	28.50	30.02	30.14	50.94
325532.20	4628100.00	29.99	29.97	30.42	30.13	50.93
324300.00	4628200.00	29.51	32.37	28.48	30.12	50.92
324800.00	4628600.00	27.15	32.99	30.18	30.11	50.91
324500.00	4629500.00	32.59	28.21	29.52	30.11	50.91
324000.00	4628000.00	29.59	31.93	28.78	30.10	50.90
324600.00	4629400.00	32.62	28.03	29.53	30.06	50.86
324500.00	4628300.00	29.12	31.89	29.15	30.05	50.85
324700.00	4629100.00	29.62	32.13	28.39	30.05	50.85
325300.00	4626700.00	31.16	27.19	31.69	30.02	50.82
324200.00	4628100.00	29.55	32.14	28.33	30.01	50.81
324500.00	4627800.00	29.82	31.00	29.19	30.01	50.81

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
325200.00	4628800.00	27.76	32.60	29.58	29.98	50.78
325126.50	4627944.00	30.91	29.23	29.78	29.98	50.78
326255.70	4627354.50	28.46	26.77	34.56	29.93	50.73
325500.00	4626800.00	31.22	28.91	29.62	29.91	50.71
324750.00	4624750.00	26.52	28.95	34.22	29.89	50.69
325100.00	4629100.00	29.68	30.82	29.18	29.89	50.69
324700.00	4629200.00	29.96	30.16	29.46	29.86	50.66
325900.00	4626900.00	30.56	25.43	33.58	29.86	50.66
324755.70	4627727.20	29.58	28.59	31.37	29.85	50.65
324109.30	4627740.40	29.39	30.44	29.68	29.84	50.64
324100.00	4629500.00	31.56	27.95	30.00	29.84	50.64
324108.60	4627717.30	29.61	30.23	29.65	29.83	50.63
324900.00	4628600.00	26.96	32.75	29.78	29.83	50.63
324700.00	4629500.00	32.43	27.49	29.54	29.82	50.62
325200.00	4629100.00	29.06	31.17	29.24	29.82	50.62
325300.00	4628900.00	28.09	32.64	28.73	29.82	50.62
324800.00	4628500.00	27.82	31.80	29.80	29.81	50.61
325100.00	4626700.00	26.60	29.27	33.55	29.80	50.60
324400.00	4628200.00	29.35	32.08	27.97	29.80	50.60
325200.00	4628900.00	28.04	32.97	28.39	29.80	50.60
324427.50	4627729.50	29.75	30.21	29.42	29.79	50.59
324100.00	4627700.00	29.52	30.19	29.66	29.79	50.59
324700.00	4627900.00	29.61	29.19	30.50	29.77	50.57
325000.00	4629100.00	29.65	30.96	28.69	29.76	50.56
324300.00	4629500.00	32.31	28.20	28.78	29.76	50.56
325190.00	4628004.00	29.69	28.64	30.94	29.75	50.55
324800.00	4629200.00	29.67	30.89	28.68	29.75	50.55
324756.70	4627765.40	29.19	29.19	30.85	29.74	50.54
326305.10	4627355.40	28.41	26.58	34.23	29.74	50.54
324154.80	4627738.80	29.48	30.22	29.50	29.73	50.53
325200.00	4626300.00	29.48	27.56	32.11	29.72	50.52
326200.00	4627300.00	28.82	26.62	33.62	29.69	50.49
324600.00	4629500.00	32.56	27.87	28.62	29.68	50.48
324900.00	4626600.00	26.02	30.02	32.99	29.67	50.47
324000.00	4627300.00	30.04	26.37	32.57	29.66	50.46
324849.40	4627802.40	30.14	28.84	29.95	29.64	50.44
324803.60	4627803.10	29.57	29.39	29.94	29.63	50.43
324400.00	4629500.00	32.51	27.83	28.50	29.61	50.41
325300.00	4628800.00	28.05	31.93	28.76	29.58	50.38
324600.00	4629300.00	31.02	28.22	29.50	29.58	50.38
324500.00	4628200.00	29.14	31.36	28.22	29.58	50.38
325500.00	4629100.00	26.69	31.66	30.32	29.55	50.35
324700.00	4628400.00	28.58	31.20	28.88	29.55	50.35
326000.00	4627100.00	27.65	26.16	34.83	29.55	50.35
325500.00	4626700.00	29.65	29.67	29.31	29.54	50.34
325100.00	4628900.00	27.46	33.21	27.95	29.54	50.34
324200.20	4627737.30	29.28	29.99	29.31	29.53	50.33
324900.00	4627900.00	29.84	28.26	30.40	29.50	50.30
325400.00	4628900.00	27.30	32.23	28.96	29.50	50.30
324400.00	4627800.00	28.72	30.55	29.21	29.49	50.29
324757.80	4627803.70	29.26	29.52	29.70	29.49	50.29
324600.00	4628300.00	29.04	31.71	27.68	29.48	50.28
324900.00	4629100.00	29.47	31.45	27.46	29.46	50.26
324800.00	4629500.00	31.97	27.05	29.22	29.42	50.22
326354.60	4627356.20	28.15	26.19	33.90	29.41	50.21
324382.10	4627731.10	28.64	30.13	29.46	29.41	50.21
324336.60	4627732.60	28.61	30.03	29.58	29.41	50.21
324700.00	4629300.00	30.49	28.52	29.20	29.40	50.20
325000.00	4628600.00	27.09	31.79	29.33	29.40	50.20
325300.00	4629000.00	26.57	32.45	29.17	29.40	50.20
324100.00	4628000.00	29.26	31.15	27.76	29.39	50.19
324291.10	4627734.20	28.77	29.93	29.47	29.39	50.19

SOLVAY2016_1.2_004742

Table D-5

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
324245.70	4627735.70	29.03	29.80	29.29	29.38	50.18
324200.00	4627800.00	28.27	30.46	29.39	29.37	50.17
324900.00	4629200.00	29.34	30.91	27.84	29.36	50.16
324000.00	4627900.00	29.10	30.34	28.62	29.36	50.16
324300.00	4628100.00	29.27	31.34	27.42	29.34	50.14
324200.00	4628000.00	28.87	30.47	28.68	29.34	50.14
324600.00	4628000.00	29.88	28.09	30.03	29.34	50.14
325100.00	4628700.00	27.03	32.15	28.79	29.32	50.12
327500.00	4625500.00	34.85	23.97	29.14	29.32	50.12
324800.00	4629100.00	29.20	31.84	26.90	29.31	50.11
326000.00	4627000.00	27.11	26.39	34.43	29.31	50.11
324900.00	4628500.00	27.91	30.72	29.28	29.30	50.10
326100.00	4627100.00	27.46	25.86	34.55	29.29	50.09
325100.00	4626600.00	25.21	30.85	31.76	29.27	50.07
324800.00	4628400.00	28.51	31.05	28.15	29.24	50.04
324400.00	4627900.00	28.57	30.52	28.58	29.22	50.02
324700.00	4629400.00	31.43	26.94	29.30	29.22	50.02
325600.00	4629000.00	27.56	31.82	28.24	29.21	50.01
325600.00	4628200.00	29.17	29.13	29.32	29.21	50.01
324300.00	4627800.00	28.44	30.09	29.02	29.18	49.98
325000.00	4629600.00	31.61	26.81	29.07	29.16	49.96
325100.00	4628000.00	29.21	28.97	29.31	29.16	49.96
325600.00	4629200.00	27.35	30.63	29.49	29.16	49.96
326200.00	4627100.00	27.28	25.89	34.29	29.15	49.95
324100.00	4627300.00	30.03	26.15	31.27	29.15	49.95
326100.00	4627200.00	28.58	24.80	34.04	29.14	49.94
324700.00	4629600.00	31.86	27.31	28.20	29.12	49.92
325500.00	4628900.00	26.69	31.64	29.00	29.11	49.91
324800.00	4629300.00	29.99	28.45	28.86	29.10	49.90
324700.00	4628300.00	28.89	31.25	27.16	29.10	49.90
326404.00	4627357.10	28.02	25.69	33.58	29.10	49.90
326300.00	4627300.00	28.76	25.63	32.88	29.09	49.89
325700.00	4628300.00	28.88	28.45	29.92	29.08	49.88
325500.00	4629000.00	27.20	32.12	27.91	29.08	49.88
324500.00	4629600.00	31.52	27.33	28.34	29.06	49.86
324300.00	4627900.00	28.35	29.90	28.92	29.06	49.86
324900.00	4629300.00	29.57	29.09	28.50	29.05	49.85
324400.00	4628100.00	29.53	30.45	27.18	29.05	49.85
324800.00	4627900.00	28.59	28.70	29.86	29.05	49.85
324300.00	4628000.00	28.44	30.20	28.46	29.03	49.83
324600.00	4628100.00	28.96	28.95	29.16	29.02	49.82
324300.00	4629600.00	30.74	26.99	29.27	29.00	49.80
326300.00	4627100.00	27.40	25.48	34.08	28.99	49.79
324100.00	4627900.00	28.47	30.05	28.42	28.98	49.78
325000.00	4628500.00	27.95	30.29	28.68	28.97	49.77
325100.00	4628600.00	27.19	30.81	28.91	28.97	49.77
325500.00	4629200.00	28.04	30.40	28.44	28.96	49.76
325000.00	4629300.00	29.33	29.49	28.03	28.95	49.75
324600.00	4629600.00	31.74	27.18	27.64	28.85	49.65
324600.00	4628200.00	28.89	30.57	27.07	28.84	49.64
324500.00	4627900.00	28.47	29.79	28.23	28.83	49.63
326000.00	4626900.00	28.31	24.70	33.32	28.78	49.58
324200.00	4627900.00	28.17	30.01	28.10	28.76	49.56
325000.00	4628000.00	28.47	28.22	29.53	28.74	49.54
325200.00	4628700.00	26.30	31.40	28.51	28.74	49.54
324900.00	4628400.00	28.43	30.40	27.37	28.73	49.53
324800.00	4629400.00	30.20	26.87	29.01	28.69	49.49
325600.00	4628900.00	27.34	30.89	27.82	28.68	49.48
325200.00	4626700.00	27.84	26.66	31.53	28.68	49.48
325400.00	4626100.00	32.68	23.50	29.84	28.68	49.48
326100.00	4626900.00	27.34	24.43	34.26	28.67	49.47
325100.00	4629300.00	28.71	29.89	27.42	28.67	49.47

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Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m³)	2009 Concentration[1] (ug/m³)	2010 Concentration[1] (ug/m³)	3-yr Average (ug/m³)	3-yr Average + Background (ug/m³)
326453.50	4627357.90	27.86	24.89	33.26	28.67	49.47
325200.00	4628100.00	28.31	27.95	29.66	28.64	49.44
325200.00	4629200.00	28.91	30.24	26.71	28.62	49.42
325100.00	4628500.00	27.94	29.83	28.01	28.59	49.39
324500.00	4628000.00	28.57	29.43	27.74	28.58	49.38
325600.00	4629100.00	25.70	31.62	28.41	28.58	49.38
325300.00	4626400.00	30.20	25.18	30.34	28.57	49.37
324500.00	4628100.00	28.92	29.50	27.27	28.56	49.36
324800.00	4628300.00	28.65	30.22	26.79	28.55	49.35
324400.00	4628000.00	27.97	29.50	28.18	28.55	49.35
326400.00	4627100.00	27.37	24.37	33.90	28.55	49.35
325600.00	4626800.00	29.20	27.26	29.16	28.54	49.34
325200.00	4628600.00	27.25	29.86	28.48	28.53	49.33
325500.00	4626600.00	30.12	27.24	28.03	28.46	49.26
325000.00	4629400.00	29.46	27.69	28.23	28.46	49.26
324700.00	4628000.00	28.61	27.92	28.80	28.44	49.24
325100.00	4629600.00	30.76	26.25	28.22	28.41	49.21
325200.00	4626500.00	26.88	27.31	31.00	28.40	49.20
326200.00	4627200.00	27.45	23.87	33.85	28.39	49.19
325800.00	4629000.00	25.99	30.96	28.17	28.38	49.18
325400.00	4626600.00	28.94	26.48	29.70	28.37	49.17
326100.00	4627000.00	26.14	24.92	34.06	28.37	49.17
325800.00	4629100.00	26.38	31.29	27.43	28.37	49.17
326503.00	4627358.80	27.70	24.38	32.95	28.34	49.14
326200.00	4627000.00	27.48	23.85	33.68	28.34	49.14
325300.00	4628700.00	26.49	30.56	27.96	28.33	49.13
326000.00	4625750.00	31.78	25.85	27.34	28.32	49.12
325270.00	4628052.00	26.79	28.25	29.94	28.32	49.12
325700.00	4628900.00	26.68	30.57	27.72	28.32	49.12
326300.00	4627200.00	27.26	23.81	33.88	28.31	49.11
325200.00	4629300.00	28.56	29.82	26.55	28.31	49.11
325400.00	4628800.00	26.87	30.76	27.22	28.28	49.08
325300.00	4626600.00	28.23	26.70	29.90	28.28	49.08
325100.00	4629400.00	29.17	27.78	27.79	28.25	49.05
326400.00	4627300.00	27.58	24.89	32.26	28.24	49.04
325000.00	4629500.00	29.92	26.37	28.43	28.24	49.04
324900.00	4628300.00	28.23	30.66	25.81	28.23	49.03
325100.00	4629200.00	28.59	30.61	25.48	28.23	49.03
325000.00	4628400.00	28.31	29.76	26.54	28.20	49.00
324900.00	4628000.00	27.25	28.64	28.71	28.20	49.00
326400.00	4627200.00	27.92	23.21	33.46	28.20	49.00
327000.00	4625500.00	31.75	24.75	28.01	28.17	48.97
324700.00	4628200.00	28.81	29.55	26.00	28.12	48.92
325700.00	4628800.00	26.06	29.49	28.79	28.11	48.91
325600.00	4628800.00	25.90	30.50	27.90	28.10	48.90
326300.00	4627000.00	27.34	23.56	33.33	28.08	48.88
325100.00	4628100.00	27.19	29.27	27.75	28.07	48.87
326552.40	4627359.60	27.44	24.06	32.64	28.05	48.85
325600.00	4629300.00	27.98	28.94	27.09	28.00	48.80
325300.00	4628600.00	27.00	29.19	27.68	27.95	48.75
324800.00	4628000.00	27.22	27.47	29.10	27.93	48.73
326601.90	4627360.50	27.34	24.05	32.34	27.91	48.71
325400.00	4628700.00	26.55	29.69	27.47	27.90	48.70
326500.00	4627100.00	27.21	23.15	33.32	27.89	48.69
325700.00	4626400.00	26.83	28.28	28.43	27.85	48.65
326200.00	4626900.00	26.64	24.27	32.62	27.84	48.64
325200.00	4626600.00	26.48	27.35	29.58	27.80	48.60
325200.00	4628500.00	27.39	29.10	26.88	27.79	48.59
325600.00	4626700.00	28.48	27.38	27.40	27.76	48.56
327000.00	4625750.00	31.33	24.04	27.85	27.74	48.54
326400.00	4627000.00	27.22	22.90	33.09	27.74	48.54
326500.00	4627000.00	27.00	23.59	32.58	27.72	48.52

SOLVAY2016_1.2_004744

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
325100.00	4629500.00	29.18	25.85	28.12	27.72	48.52
325500.00	4628700.00	25.77	29.34	28.04	27.72	48.52
326600.00	4627100.00	27.12	22.92	33.01	27.68	48.48
325500.00	4628600.00	26.42	29.46	27.14	27.68	48.48
326651.30	4627361.30	27.16	23.81	32.04	27.67	48.47
325900.00	4626800.00	27.38	24.02	31.48	27.63	48.43
325400.00	4626500.00	29.09	24.67	29.10	27.62	48.42
325300.00	4626500.00	26.89	26.91	29.01	27.61	48.41
326700.00	4627100.00	27.01	23.12	32.69	27.61	48.41
325400.00	4626400.00	29.51	23.95	29.34	27.60	48.40
324800.00	4628100.00	27.18	28.36	27.26	27.60	48.40
326500.00	4627300.00	26.92	23.67	32.18	27.59	48.39
325600.00	4626600.00	28.44	27.19	27.10	27.58	48.38
326500.00	4627200.00	26.81	22.68	33.22	27.57	48.37
325600.00	4628700.00	25.69	28.79	28.19	27.55	48.35
325500.00	4628800.00	25.71	29.95	26.97	27.54	48.34
326700.80	4627362.20	27.03	23.85	31.75	27.54	48.34
325100.00	4628400.00	27.86	29.10	25.67	27.54	48.34
326000.00	4626000.00	31.79	23.36	27.43	27.53	48.33
325400.00	4628600.00	26.65	28.68	27.20	27.51	48.31
324700.00	4628100.00	27.71	28.35	26.45	27.50	48.30
325486.70	4628100.00	27.23	27.11	28.16	27.50	48.30
326600.00	4627000.00	26.80	23.58	32.12	27.50	48.30
326300.00	4626900.00	26.42	24.23	31.82	27.49	48.29
325600.00	4626300.00	31.18	24.73	26.53	27.48	48.28
326000.00	4626800.00	27.50	23.87	30.97	27.45	48.25
326800.00	4627100.00	26.89	23.06	32.37	27.44	48.24
324800.00	4628200.00	27.72	28.49	26.00	27.40	48.20
326750.30	4627363.00	26.87	23.71	31.59	27.39	48.19
325400.00	4628500.00	26.65	29.77	25.67	27.37	48.17
326000.00	4626200.00	32.79	22.48	26.81	27.36	48.16
325000.00	4628100.00	26.61	26.96	28.48	27.35	48.15
325300.00	4628500.00	27.11	28.65	26.23	27.33	48.13
325800.00	4626800.00	26.12	25.27	30.56	27.32	48.12
326600.00	4627300.00	26.48	23.38	32.08	27.31	48.11
325700.00	4628700.00	25.49	28.79	27.60	27.29	48.09
325600.00	4628600.00	26.14	29.32	26.41	27.29	48.09
325700.00	4628400.00	26.59	27.45	27.82	27.29	48.09
326600.00	4627200.00	26.58	22.28	32.99	27.28	48.08
326700.00	4627000.00	26.60	23.50	31.71	27.27	48.07
326900.00	4627100.00	26.77	22.99	32.05	27.27	48.07
326799.70	4627363.90	26.71	23.53	31.51	27.25	48.05
325310.00	4628076.00	25.93	27.68	28.01	27.21	48.01
324900.00	4628100.00	26.78	27.73	27.10	27.20	48.00
326100.00	4626200.00	32.48	22.32	26.61	27.14	47.94
327500.00	4625000.00	27.84	27.37	26.19	27.13	47.93
327000.00	4627100.00	26.63	23.03	31.72	27.12	47.92
326700.00	4627300.00	26.12	23.25	31.98	27.12	47.92
325600.00	4628300.00	26.98	27.05	27.30	27.11	47.91
326849.20	4627364.70	26.54	23.35	31.42	27.10	47.90
324900.00	4628200.00	26.81	27.75	26.65	27.07	47.87
327168.90	4627156.90	26.47	23.18	31.55	27.07	47.87
327134.70	4627158.10	26.51	23.03	31.66	27.07	47.87
327100.40	4627159.20	26.55	22.86	31.76	27.05	47.85
326800.00	4627200.00	26.56	22.00	32.56	27.04	47.84
325500.00	4626500.00	29.10	24.28	27.72	27.03	47.83
326700.00	4627200.00	26.29	21.97	32.78	27.01	47.81
327100.00	4627100.00	26.48	23.07	31.39	26.98	47.78
325500.00	4626400.00	29.64	23.71	27.51	26.95	47.75
326800.00	4627000.00	26.40	23.15	31.31	26.95	47.75
326900.00	4627200.00	26.53	21.99	32.33	26.95	47.75
326898.70	4627365.60	26.37	23.13	31.29	26.93	47.73

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
325300.00	4628100.00	25.18	27.51	28.03	26.91	47.71
326200.00	4626800.00	26.71	23.47	30.49	26.89	47.69
327000.00	4627200.00	26.49	21.96	32.10	26.85	47.65
325700.00	4628600.00	25.76	29.12	25.63	26.84	47.64
326100.00	4626800.00	26.73	23.28	30.44	26.82	47.62
326300.00	4626800.00	25.60	23.31	31.50	26.80	47.60
325500.00	4628500.00	26.10	29.48	24.82	26.80	47.60
327200.00	4627100.00	26.33	22.99	31.05	26.79	47.59
325441.10	4628100.00	25.63	27.25	27.30	26.72	47.52
326948.10	4627366.40	26.19	22.86	31.12	26.72	47.52
326800.00	4627300.00	25.66	22.61	31.90	26.72	47.52
327000.00	4627300.00	25.59	22.92	31.65	26.72	47.52
325300.00	4628400.00	26.52	29.69	23.91	26.71	47.51
325000.00	4628300.00	27.28	28.29	24.50	26.69	47.49
325200.00	4628400.00	27.03	28.23	24.76	26.67	47.47
326900.00	4627300.00	25.53	22.70	31.78	26.67	47.47
325700.00	4626600.00	27.58	25.80	26.52	26.64	47.44
326900.00	4627000.00	26.19	22.79	30.91	26.63	47.43
325700.00	4626200.00	31.72	22.24	25.92	26.63	47.43
327300.00	4627100.00	26.16	22.99	30.72	26.62	47.42
327099.60	4627201.20	25.99	21.94	31.85	26.59	47.39
326500.00	4626900.00	26.01	22.59	31.18	26.59	47.39
327098.10	4627285.10	25.20	22.92	31.61	26.58	47.38
327000.00	4627000.00	25.97	23.18	30.51	26.55	47.35
325800.00	4626700.00	26.41	26.48	26.75	26.55	47.35
326750.00	4625750.00	30.61	21.80	27.22	26.55	47.35
326400.00	4626900.00	26.15	22.13	31.30	26.53	47.33
326997.60	4627367.30	26.01	22.59	30.94	26.51	47.31
326250.00	4625750.00	29.42	23.95	26.16	26.51	47.31
327098.90	4627243.10	25.11	22.50	31.80	26.47	47.27
325600.00	4626400.00	29.92	23.92	25.52	26.45	47.25
325600.00	4626500.00	28.52	24.54	26.28	26.45	47.25
327100.00	4627000.00	25.75	23.48	30.11	26.44	47.24
325700.00	4626700.00	26.71	26.72	25.86	26.43	47.23
327097.30	4627327.00	25.29	22.64	31.28	26.40	47.20
325395.50	4628100.00	24.87	27.12	27.17	26.39	47.19
327250.00	4625000.00	26.49	25.85	26.67	26.34	47.14
327047.00	4627368.10	25.83	22.33	30.86	26.34	47.14
325800.00	4626100.00	30.68	22.14	26.10	26.31	47.11
327200.00	4627000.00	25.52	23.65	29.71	26.29	47.09
325700.00	4628500.00	24.98	28.75	25.05	26.26	47.06
326600.00	4626900.00	25.70	22.50	30.57	26.26	47.06
325900.00	4626100.00	30.25	21.63	26.77	26.22	47.02
327096.50	4627369.00	25.65	22.28	30.69	26.21	47.01
325600.00	4628500.00	25.53	29.14	23.94	26.20	47.00
325600.00	4628400.00	25.04	28.22	25.33	26.20	47.00
325800.00	4626200.00	31.07	21.78	25.64	26.16	46.96
325100.00	4628300.00	26.56	27.83	23.94	26.11	46.91
327300.00	4627000.00	25.28	23.74	29.31	26.11	46.91
325400.00	4628400.00	25.81	29.25	23.25	26.11	46.91
325000.00	4628200.00	25.68	27.53	25.05	26.09	46.89
325350.00	4628100.00	25.08	27.53	25.55	26.05	46.85
326400.00	4626800.00	24.36	23.14	30.62	26.04	46.84
325500.00	4628400.00	25.25	26.34	26.53	26.04	46.84
326000.00	4626100.00	30.15	21.36	26.61	26.04	46.84
326000.00	4626700.00	24.96	24.91	28.23	26.03	46.83
325900.00	4626700.00	25.28	25.11	27.68	26.03	46.83
326700.00	4626900.00	25.40	22.57	30.01	25.99	46.79
326250.00	4626000.00	29.52	21.82	26.53	25.96	46.76
325700.00	4626300.00	29.29	23.53	24.99	25.94	46.74
325300.00	4628200.00	24.75	26.87	26.15	25.93	46.73
325700.00	4626400.00	29.47	23.55	24.73	25.92	46.72

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
327400.00	4627000.00	25.04	23.76	28.92	25.91	46.71
325100.00	4628200.00	25.50	27.27	24.92	25.90	46.70
326800.00	4626900.00	25.12	22.95	29.52	25.87	46.67
326100.00	4626100.00	29.97	21.40	26.21	25.86	46.66
325800.00	4626600.00	27.50	24.05	25.97	25.84	46.64
325200.00	4628300.00	25.83	27.68	23.64	25.72	46.52
326750.00	4626000.00	29.45	20.69	26.95	25.70	46.50
326900.00	4626900.00	24.84	23.06	29.05	25.65	46.45
327000.00	4626000.00	28.79	21.11	26.91	25.61	46.41
325500.00	4628100.00	25.09	28.77	22.70	25.52	46.32
325400.00	4628200.00	24.75	26.68	25.14	25.52	46.32
325300.00	4628300.00	25.09	27.89	23.52	25.50	46.30
326200.00	4626200.00	30.52	20.89	25.01	25.48	46.28
327000.00	4626900.00	24.56	23.25	28.58	25.46	46.26
327500.00	4625750.00	28.72	22.24	25.40	25.46	46.26
327750.00	4625500.00	28.99	22.33	24.97	25.43	46.23
326200.00	4626100.00	29.52	21.42	25.34	25.43	46.23
325200.00	4628200.00	24.42	27.31	24.32	25.35	46.15
325900.00	4626200.00	30.22	20.80	24.92	25.31	46.11
327100.00	4626900.00	24.29	23.52	28.14	25.31	46.11
326500.00	4626800.00	24.31	23.10	28.51	25.31	46.11
325700.00	4626500.00	28.31	24.70	22.84	25.28	46.08
326600.00	4626800.00	24.09	23.34	28.25	25.23	46.03
325400.00	4628300.00	24.28	27.26	24.11	25.22	46.02
327200.00	4626900.00	24.00	23.71	27.70	25.14	45.94
326400.00	4626700.00	23.58	23.74	27.88	25.06	45.86
327250.00	4626000.00	27.80	21.02	26.32	25.05	45.85
325800.00	4626400.00	29.16	22.99	22.91	25.02	45.82
326200.00	4626700.00	24.27	23.21	27.37	24.95	45.75
325500.00	4628300.00	23.78	27.00	24.00	24.93	45.73
325800.00	4626300.00	28.55	21.90	24.26	24.90	45.70
326500.00	4626000.00	28.17	20.38	26.08	24.88	45.68
326300.00	4626100.00	29.32	20.47	24.79	24.86	45.66
327300.00	4626900.00	23.72	23.51	27.26	24.83	45.63
325900.00	4626600.00	25.02	23.64	25.78	24.81	45.61
326250.00	4625500.00	26.67	24.33	23.34	24.78	45.58
326800.00	4626100.00	30.15	19.45	24.68	24.76	45.56
325800.00	4626500.00	27.10	24.34	22.83	24.76	45.56
325900.00	4626400.00	29.00	22.11	23.11	24.74	45.54
326000.00	4626300.00	27.73	22.51	23.95	24.73	45.53
326700.00	4626800.00	23.52	22.99	27.68	24.73	45.53
326600.00	4626200.00	29.83	19.79	24.55	24.72	45.52
326000.00	4626600.00	24.89	23.21	25.90	24.67	45.47
327400.00	4626900.00	23.44	23.65	26.82	24.64	45.44
326100.00	4626300.00	28.00	21.81	24.00	24.60	45.40
325900.00	4626300.00	27.74	22.02	23.98	24.58	45.38
326400.00	4626700.00	25.70	21.03	26.83	24.52	45.32
326300.00	4626200.00	29.48	20.06	24.00	24.51	45.31
326400.00	4626100.00	29.11	20.20	24.15	24.49	45.29
326900.00	4626100.00	29.92	19.13	24.34	24.46	45.26
327000.00	4626100.00	29.74	19.07	24.57	24.46	45.26
326500.00	4626700.00	25.13	21.96	26.22	24.44	45.24
327500.00	4626900.00	23.15	23.76	26.39	24.43	45.23
326500.00	4626100.00	29.34	19.49	24.46	24.43	45.23
326300.00	4626700.00	25.32	21.09	26.88	24.43	45.23
326000.00	4626400.00	28.68	21.20	23.35	24.41	45.21
326600.00	4626100.00	29.39	19.35	24.32	24.35	45.15
326400.00	4626400.00	28.06	19.78	25.18	24.34	45.14
326800.00	4626800.00	23.17	22.61	27.10	24.29	45.09
326200.00	4626600.00	23.85	22.12	26.86	24.28	45.08
326700.00	4626100.00	29.42	19.17	24.13	24.24	45.04
326700.00	4626200.00	28.78	19.37	24.52	24.22	45.02

Table D-5

Cumulative Analysis - 1-hr SO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m^3)	2009 Concentration[1] (ug/m^3)	2010 Concentration[1] (ug/m^3)	3-yr Average (ug/m^3)	3-yr Average + Background (ug/m^3)
326300.00	4626400.00	28.17	19.82	24.68	24.22	45.02
326600.00	4626400.00	27.54	19.29	25.83	24.22	45.02
326100.00	4626600.00	24.29	22.43	25.72	24.15	44.95
327600.00	4626900.00	22.85	23.47	25.94	24.09	44.89
326100.00	4626400.00	28.39	20.18	23.68	24.08	44.88
326200.00	4626400.00	28.26	19.77	24.16	24.06	44.86
326500.00	4626400.00	27.81	19.51	24.80	24.04	44.84
327100.00	4626100.00	28.59	18.97	24.54	24.03	44.83
326400.00	4626200.00	28.97	19.45	23.68	24.03	44.83
326900.00	4626800.00	22.85	22.57	26.59	24.00	44.80
326300.00	4626600.00	23.75	21.44	26.82	24.00	44.80
326700.00	4626400.00	27.27	19.31	25.38	23.99	44.79
325900.00	4626500.00	26.26	22.18	23.48	23.97	44.77
326400.00	4626500.00	24.99	19.95	26.80	23.92	44.72
326200.00	4626300.00	27.32	20.39	23.80	23.84	44.64
327000.00	4626800.00	22.54	22.85	26.10	23.83	44.63
326800.00	4626200.00	28.06	18.97	24.47	23.83	44.63
326500.00	4626200.00	28.54	19.03	23.77	23.78	44.58
327200.00	4626100.00	27.68	19.05	24.55	23.76	44.56
326600.00	4626700.00	23.46	22.09	25.68	23.75	44.55
326100.00	4626300.00	25.14	21.05	24.89	23.69	44.49
326500.00	4626500.00	25.04	19.46	26.47	23.66	44.46
326200.00	4626500.00	25.00	20.46	25.46	23.64	44.44
326000.00	4626500.00	25.30	21.42	24.13	23.62	44.42
326900.00	4626200.00	27.73	18.58	24.36	23.56	44.36
326400.00	4626300.00	26.76	19.66	24.22	23.55	44.35
326300.00	4626300.00	27.11	19.49	24.00	23.53	44.33
327200.00	4626200.00	27.40	19.09	24.06	23.52	44.32
327100.00	4626800.00	22.34	22.55	25.65	23.51	44.31
327100.00	4626200.00	27.38	18.91	24.15	23.48	44.28
327000.00	4626200.00	27.38	18.73	24.25	23.45	44.25
327300.00	4626200.00	27.36	18.98	23.94	23.43	44.23
326300.00	4626500.00	24.97	19.87	25.39	23.41	44.21
326700.00	4626700.00	23.23	21.86	25.10	23.40	44.20
326400.00	4626600.00	23.74	21.00	25.34	23.36	44.16
326800.00	4626300.00	26.01	19.26	24.78	23.35	44.15
326500.00	4626300.00	26.53	19.52	23.91	23.32	44.12
326600.00	4626500.00	26.31	19.03	24.60	23.31	44.11
326600.00	4626600.00	23.58	20.71	25.58	23.29	44.09
326800.00	4626400.00	27.00	19.20	23.56	23.26	44.06
326700.00	4626500.00	26.53	18.91	24.26	23.23	44.03
326700.00	4626600.00	23.48	20.31	25.89	23.23	44.03
326900.00	4626300.00	25.96	19.33	24.33	23.21	44.01
327200.00	4626800.00	22.14	22.16	25.20	23.17	43.97
327300.00	4626100.00	26.56	18.39	24.47	23.14	43.94
326600.00	4626300.00	26.37	19.51	23.51	23.13	43.93
326900.00	4626500.00	26.02	18.74	24.53	23.10	43.90
326700.00	4626300.00	26.24	19.54	23.42	23.07	43.87
327300.00	4626800.00	21.93	22.38	24.75	23.02	43.82
326800.00	4626500.00	26.31	18.83	23.93	23.02	43.82
327000.00	4626500.00	25.72	18.86	24.40	22.99	43.79
326900.00	4626400.00	26.73	19.13	23.11	22.99	43.79
326800.00	4626700.00	22.91	21.77	24.26	22.98	43.78
326800.00	4626600.00	23.36	19.94	25.61	22.97	43.77
326500.00	4626600.00	23.68	20.53	24.47	22.89	43.69
327400.00	4626800.00	21.69	22.64	24.30	22.88	43.68
327100.00	4626400.00	26.84	18.90	22.72	22.83	43.63
327000.00	4626300.00	25.93	19.22	23.18	22.78	43.58
327400.00	4626100.00	26.24	18.40	23.61	22.75	43.55
327500.00	4626800.00	21.46	22.91	23.86	22.74	43.54
327800.00	4626400.00	26.63	19.02	22.51	22.72	43.52
327200.00	4626400.00	26.77	18.81	22.51	22.70	43.50

Cumulative Analysis – 1-hr NO_2 Results

UTM(E) (m)	UTM (N) (m)	2008 Concentration[1] (ug/m³)	2009 Concentration[1] (ug/m³)	2010 Concentration[1] (ug/m³)	3-yr Average (ug/m³)	3-yr Average + Background (ug/m³)
327100.00	4626300.00	25.87	19.11	23.11	22.70	43.50
326900.00	4626700.00	22.59	21.68	23.78	22.68	43.48
327200.00	4626300.00	25.88	19.01	23.03	22.64	43.44
327600.00	4626800.00	21.21	23.08	23.42	22.57	43.37
326900.00	4626600.00	23.21	20.10	24.39	22.57	43.37
327000.00	4626700.00	22.30	22.04	23.31	22.55	43.35
327200.00	4626500.00	25.28	19.64	22.48	22.47	43.27
327100.00	4626500.00	25.45	19.16	22.74	22.45	43.25
327600.00	4626300.00	25.88	18.61	22.72	22.40	43.20
328100.00	4626300.00	25.48	19.39	22.31	22.40	43.20
327700.00	4626800.00	20.96	23.20	22.99	22.38	43.18
327300.00	4626400.00	26.67	18.72	21.71	22.37	43.17
327800.00	4626300.00	25.88	18.60	22.56	22.34	43.14
327700.00	4626300.00	25.87	18.51	22.64	22.34	43.14
327500.00	4626400.00	26.27	19.07	21.60	22.31	43.11
327300.00	4626500.00	25.09	19.63	22.19	22.30	43.10
327500.00	4626300.00	25.89	18.71	22.29	22.29	43.09
327400.00	4626400.00	26.51	18.69	21.66	22.28	43.08
327100.00	4626700.00	22.00	21.91	22.77	22.23	43.03
327000.00	4626600.00	23.04	20.60	22.93	22.19	42.99
327100.00	4626600.00	22.89	20.83	22.62	22.11	42.91
327800.00	4626800.00	20.73	23.01	22.58	22.11	42.91
328200.00	4626300.00	24.95	19.11	22.23	22.10	42.90
327200.00	4626600.00	22.80	21.04	22.40	22.08	42.88
327400.00	4626500.00	24.92	19.34	21.93	22.06	42.86
327800.00	4626400.00	25.57	19.09	21.42	22.03	42.83
328000.00	4626200.00	25.68	18.26	22.11	22.02	42.82
327900.00	4626200.00	25.82	18.36	21.80	21.99	42.79
327800.00	4626200.00	25.95	18.46	21.42	21.94	42.74
327900.00	4626400.00	25.35	19.06	21.36	21.92	42.72
327200.00	4626700.00	21.75	21.66	22.34	21.92	42.72
327300.00	4626600.00	22.71	20.75	22.17	21.88	42.68
328000.00	4626400.00	25.15	19.04	21.30	21.83	42.63
328100.00	4626400.00	24.93	19.02	21.23	21.73	42.53
327400.00	4626600.00	22.60	20.46	21.94	21.67	42.47
327300.00	4626700.00	21.49	21.40	21.90	21.60	42.40
327600.00	4626500.00	24.57	18.76	21.41	21.58	42.38
328250.00	4626000.00	25.58	17.71	21.19	21.49	42.29
327500.00	4626600.00	22.50	20.18	21.71	21.46	42.26
328000.00	4626100.00	25.32	18.19	20.81	21.44	42.24
327700.00	4626500.00	24.36	18.66	21.12	21.38	42.18
328100.00	4626100.00	25.14	18.07	20.61	21.27	42.07
327400.00	4626700.00	21.21	21.12	21.47	21.27	42.07
327600.00	4626600.00	22.38	19.90	21.47	21.25	42.05
327800.00	4626500.00	24.15	18.65	20.83	21.21	42.01
327900.00	4626500.00	23.96	18.65	20.57	21.06	41.86
327700.00	4626600.00	22.24	19.59	21.21	21.02	41.82
327500.00	4626700.00	20.94	20.85	21.15	20.98	41.78
327600.00	4626700.00	20.67	20.58	20.95	20.74	41.54

[1] Fourth Highest Maximum Daily 1-hr Value.

Table D-4

Cumulative Analysis - 3-hr SO_2 Results

Year	UTM(E)	UTM(N)	Concentration[1]	Concentration+Background
	(m)	(m)	($\mu g/m^3$)	($\mu g/m^3$)
2008	324703.80	4627195.20	62.79	78.39
2009	324703.80	4627195.20	81.48	97.08
2010	324703.80	4627195.20	80.57	96.17

[1] Highest-Second Highest 3-hr Concentration

Table D-5
Cumulative Analysis - 24-hr SO_2 Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] (ug/m^3)	Concentration+Background (ug/m^3)
2008	324703.80	4627195.20	33.57	38.77
2009	324703.80	4627195.20	44.76	49.96
2010	324703.80	4627195.20	57.10	62.30

[1] Highest-Second Highest 24-hr Concentration

Table B-6

Cumulative Analysis - 24-hr $PM_{2.5}$ Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] (ug/m³)	Concentration+Background (ug/m³)
2008	325158.90	4627182.00	5.92	14.92
2009	325158.90	4627182.00	5.99	14.99
2010	325117.60	4627184.10	3.94	12.94

[1] Highest 24-hr Concentration

Table D-7
Cumulative Analysis - 1-hr CO Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] (ug/m^3)
2008	324723.80	4627194.90	9476.40
2009	324723.80	4627194.90	9163.72
2010	324723.80	4627194.90	12517.23

[1] Highest-Second Highest 1-hr Concentration

Table D-8
Cumulative Analysis - 8-hr CO Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	324703.80	4627195.20	3721.89
2009	324703.80	4627195.20	4800.19
2010	324723.80	4627194.90	4109.41

[1] Highest-Second Highest 8-hr Concentration

Figure D-1

Cumulative Analysis – 1-hr NO_2 Results

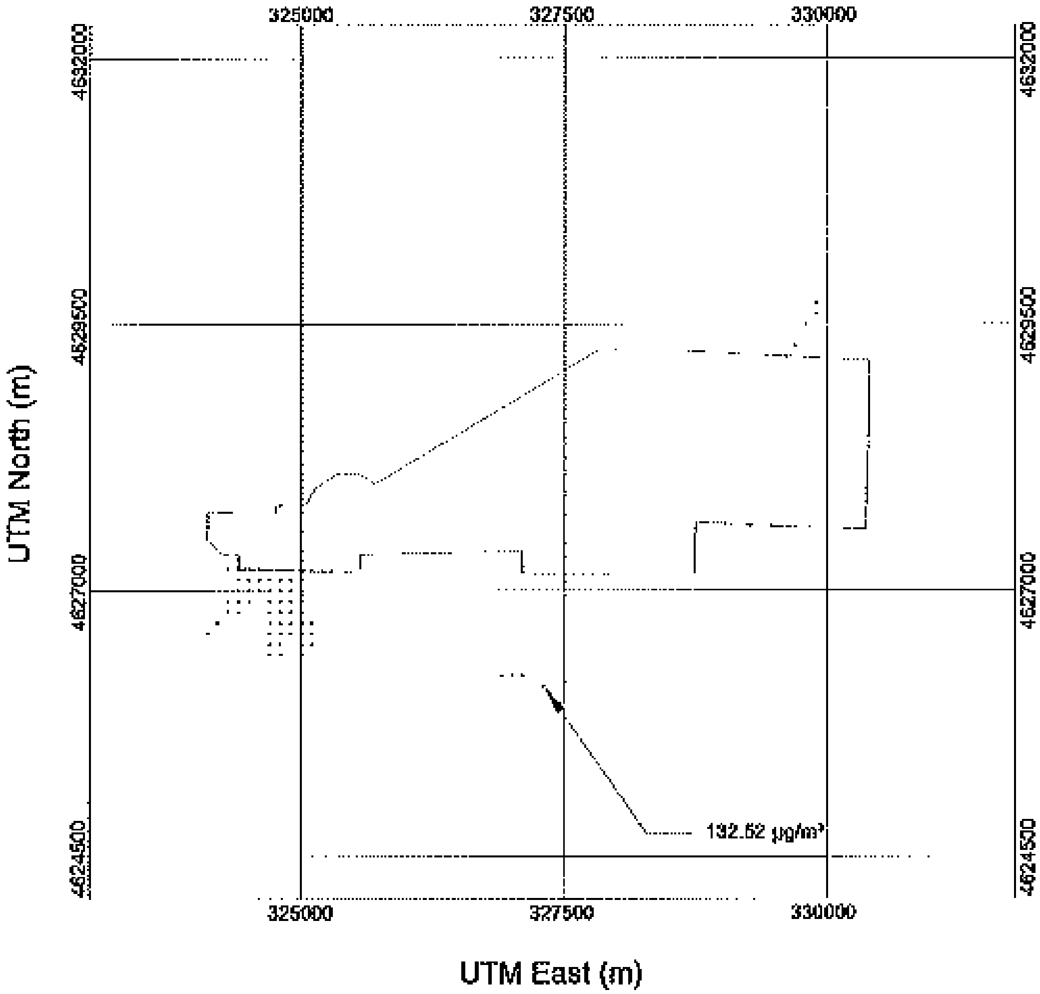

Figure D-2

Cumulative Analysis – Annual NO_2 Results

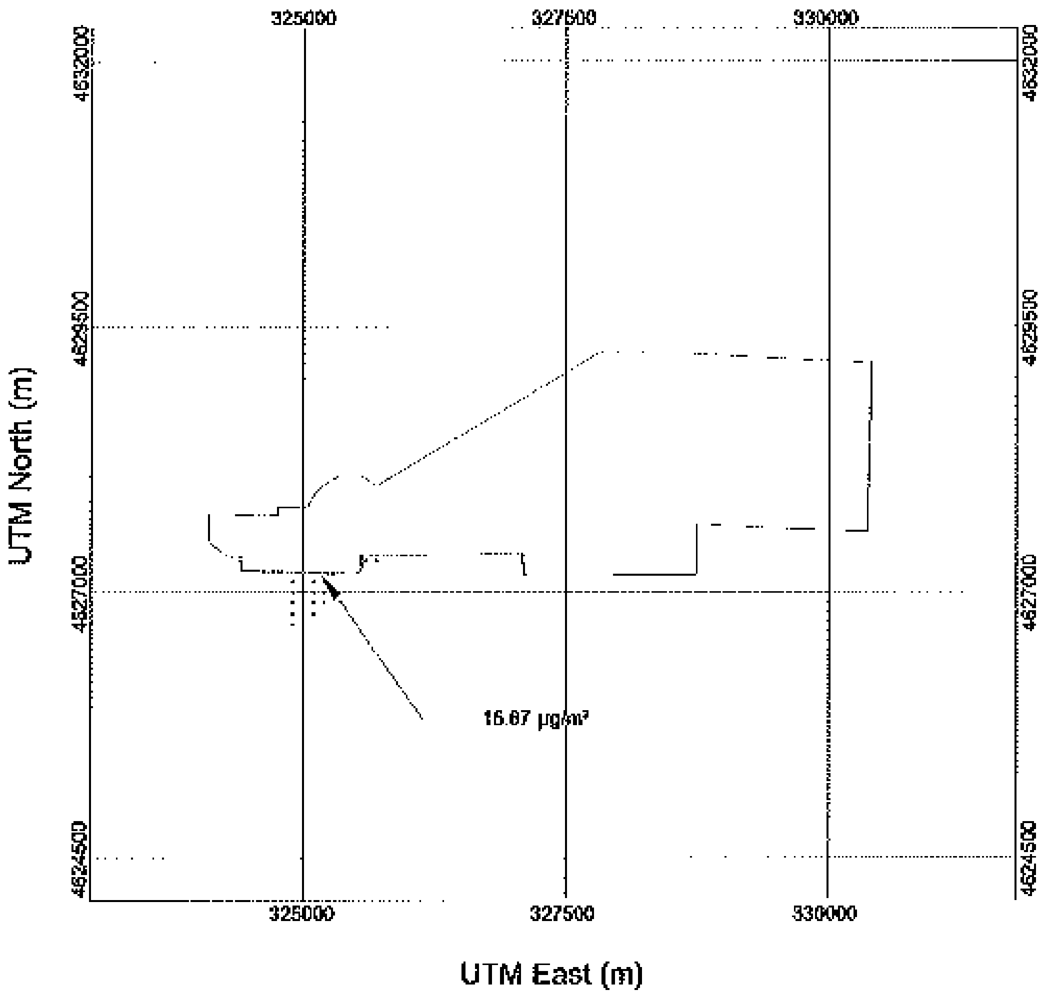

Figure D-3

Cumulative Analysis – 1-hr SO_2 Results

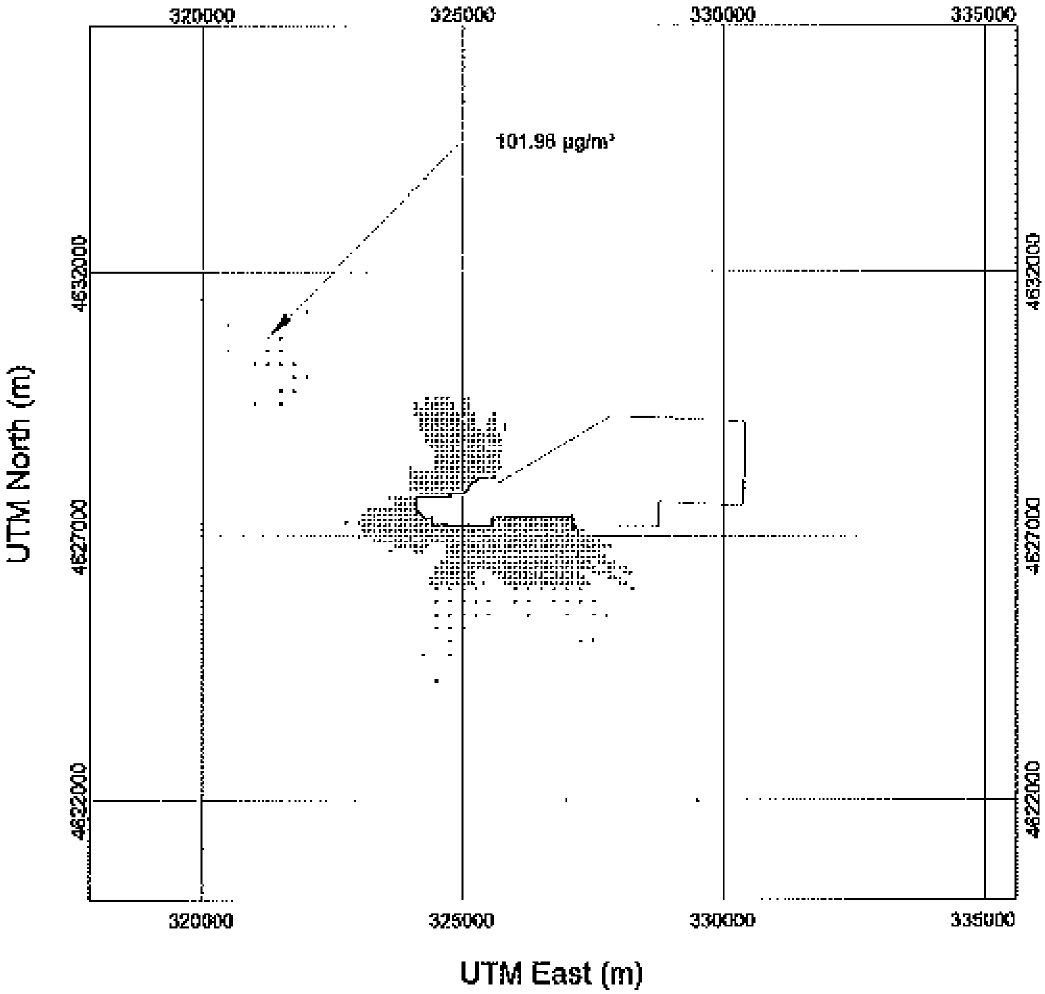

Figure D-4

Cumulative Analysis – 3-hr SO_2 Results

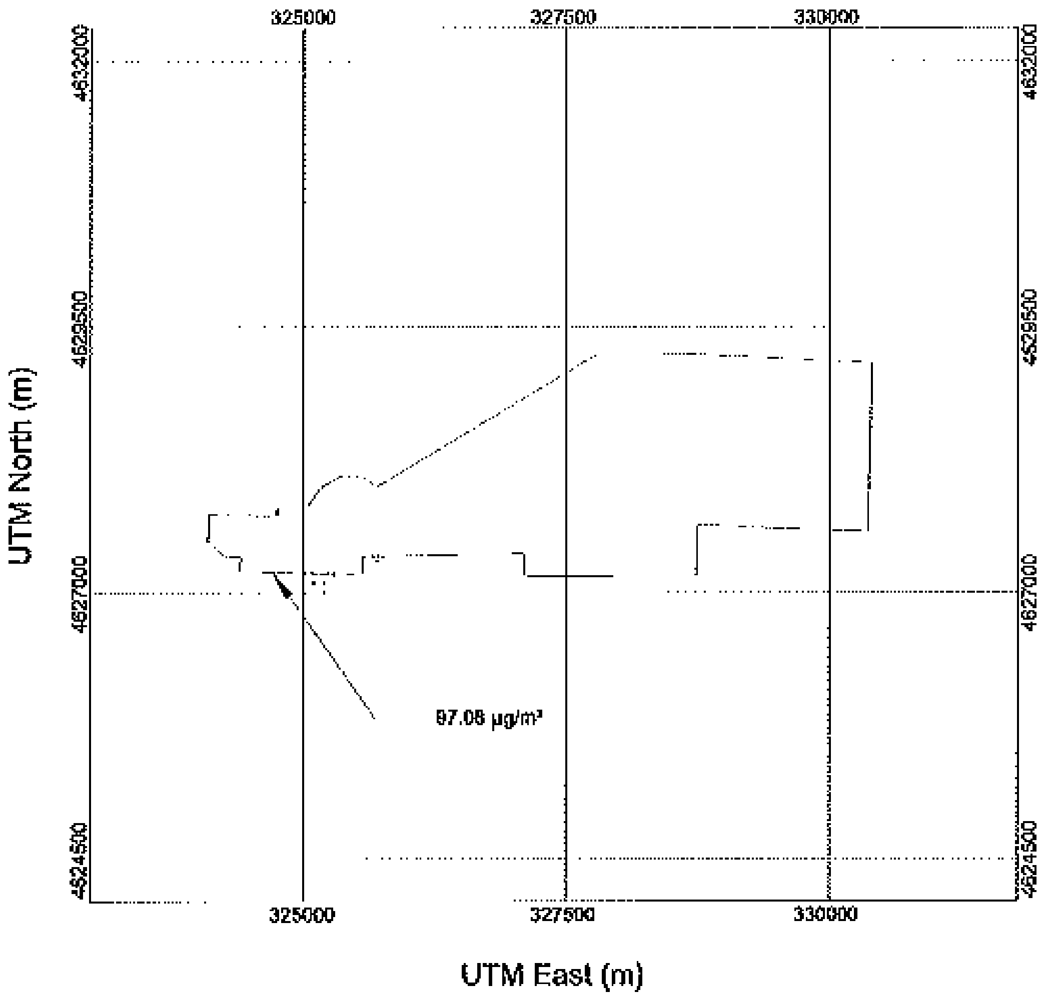

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Figure D-5

Cumulative Analysis – 24-hr SO_2 Results

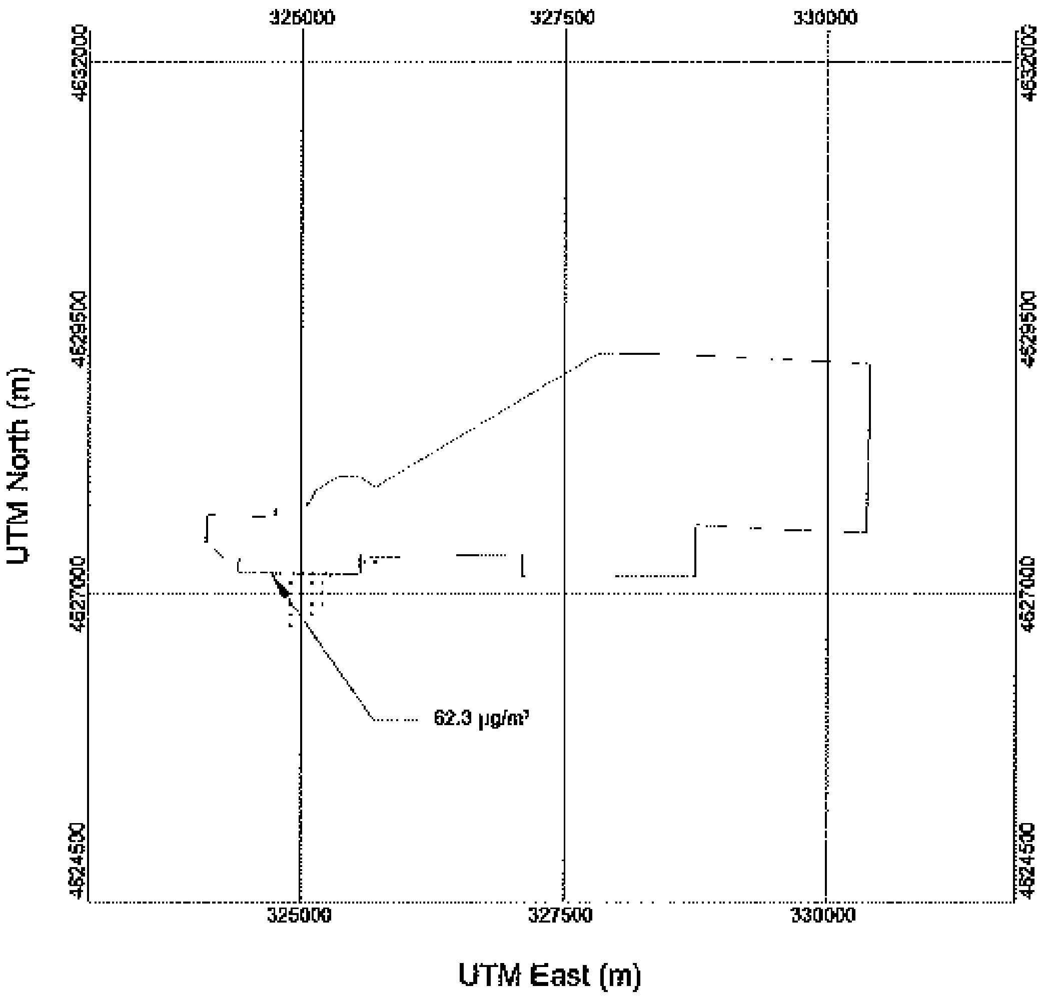


Figure D-6

Cumulative Analysis – 24-hr $PM_{2.5}$ Results

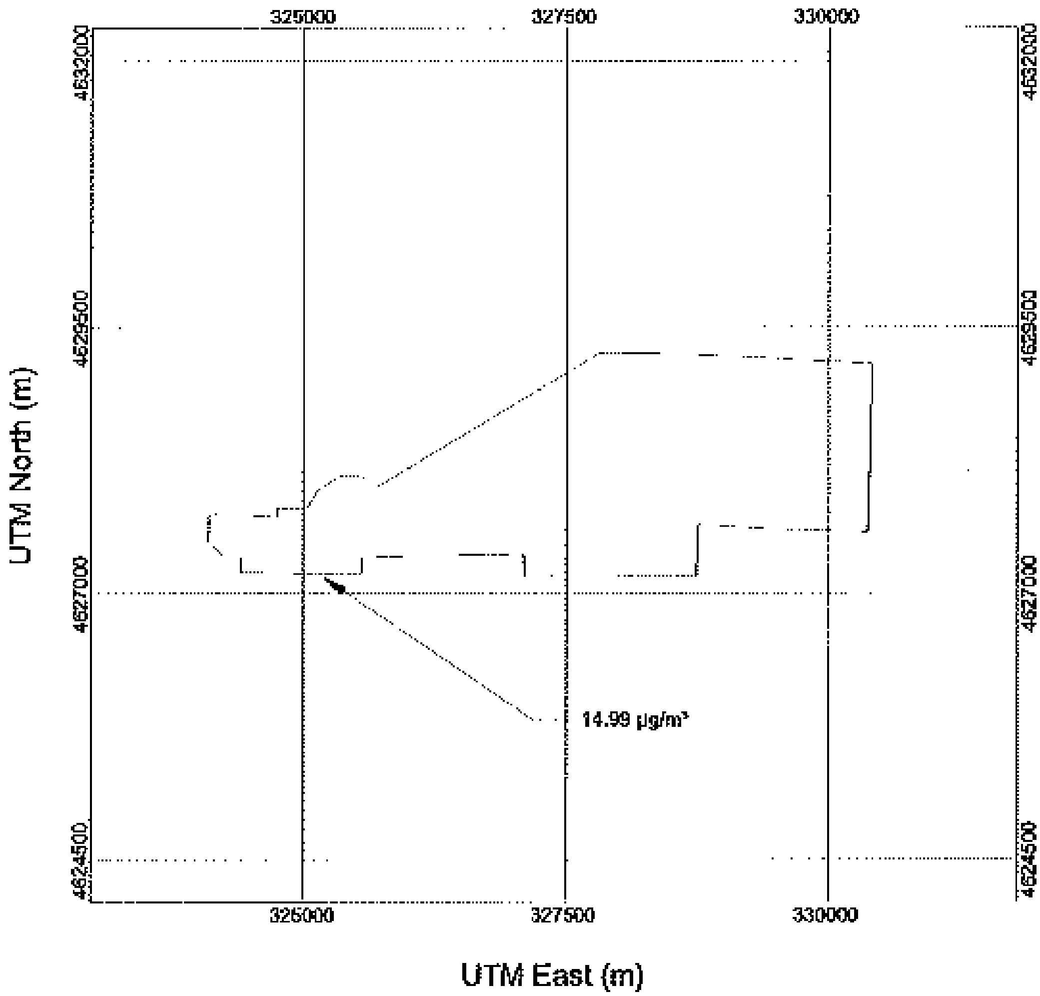


Figure D-7

Cumulative Analysis – 1-hr CO Results

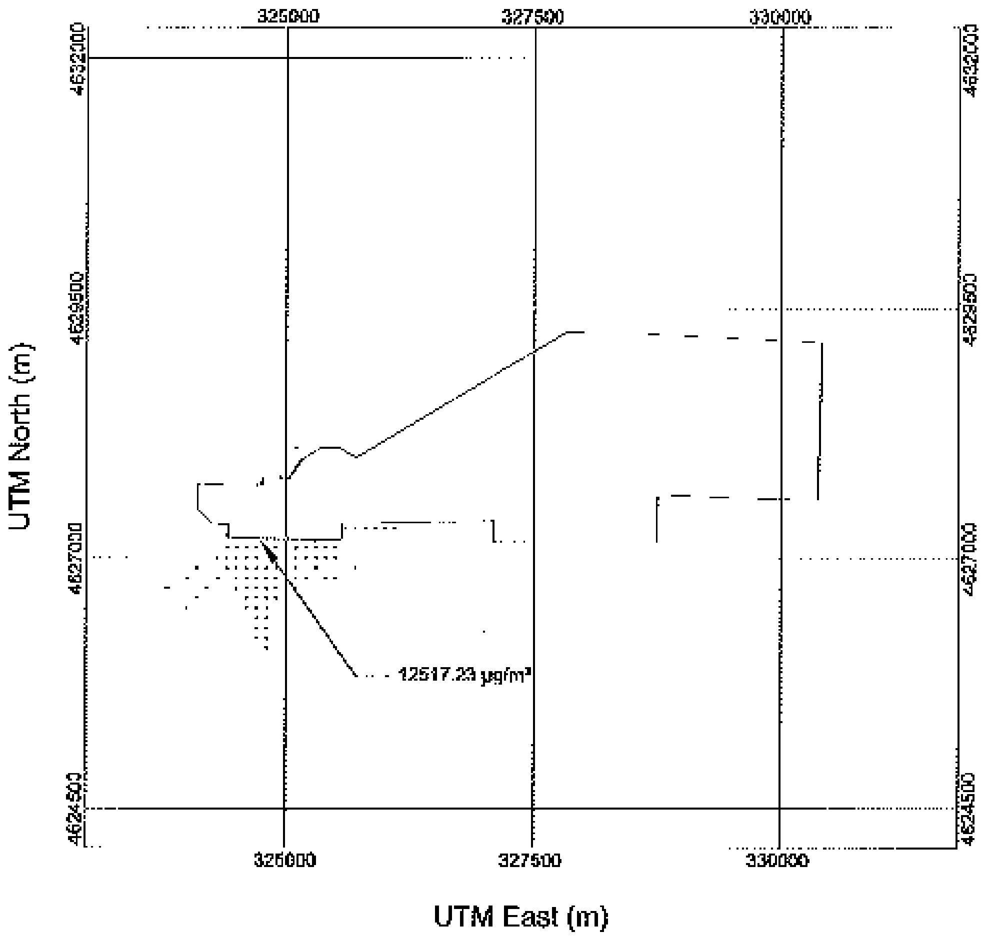
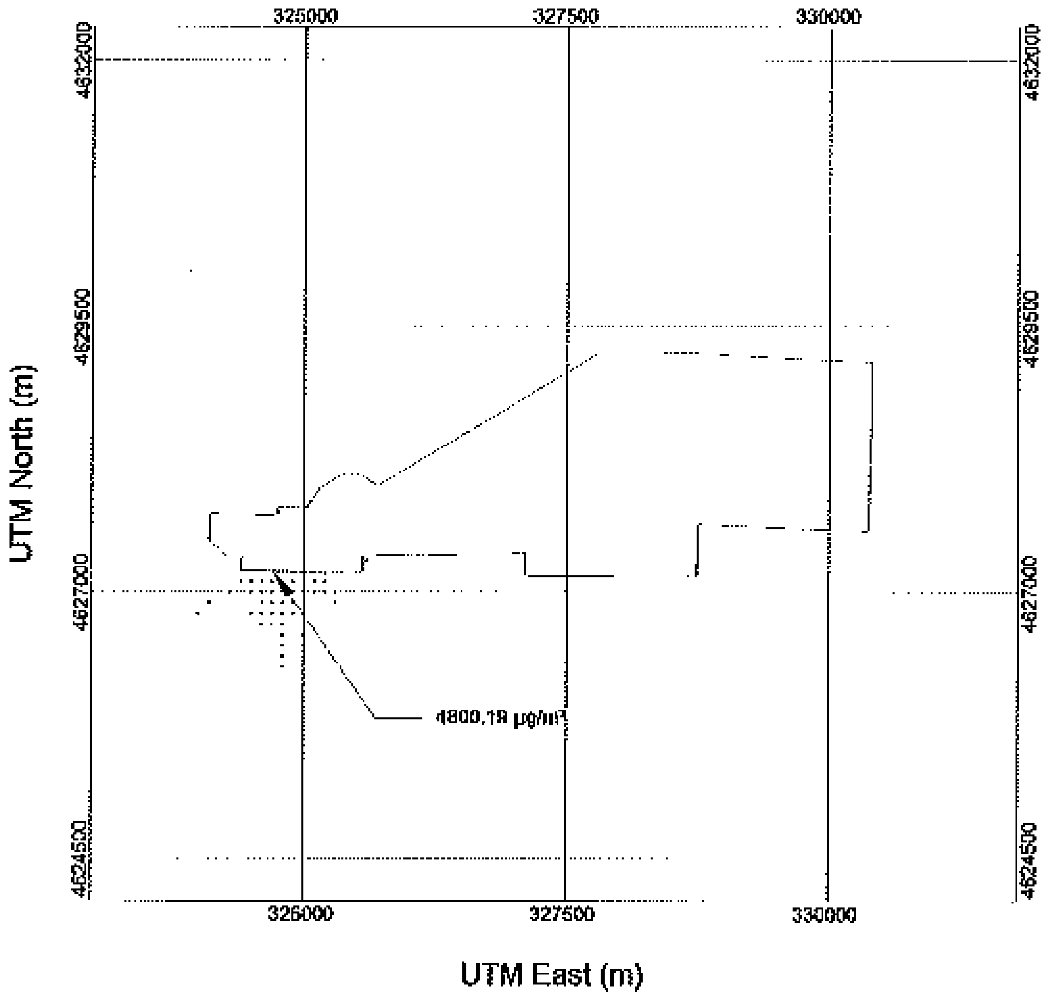


Figure D-8

Cumulative Analysis – 8-hr CO Results



APPENDIX E
INHALATION RISK ANALYSIS INFORMATION

The following attachments are included in this appendix in the following order:

- Table E-1: Inhalation Risk Assessment – HAP Emission Rates (g/s)
- Table E-2: Inhalation Risk Assessment – Maximum Modeled Unit Emission Rates
- Table E-3: Inhalation Risk Assessment – Maximum Ambient Concentration (ug/m^3)
- Table E-4: Inhalation Risk Assessment – Unit Risk Factors for HAPs
- Table E-5: Inhalation Risk Assessment – Cancer Risk by Source and Total Risk

Table E-1
Inhalation Risk Assessment - HAP Emission Rates (g/s)

	New Sources				Modified Sources					
Pollutant	852 Heater	New Emergency Air Compressor	100 M bbl Tank	Fugitive Emissions	501 Crude Heater	501 Vacuum Heater	Coker Unit Flare	Naphtha Splitter Heater	Heater H5	HDS Heater
Arsenic	1.21E-06	7.71E-08	-	-	5.61E-06	1.55E-06	2.42E-06	1.12E-06	1.09E-06	4.01E-07
Beryllium	7.86E-07	5.80E-08	-	-	3.67E-06	1.06E-06	1.57E-06	7.28E-07	7.06E-07	5.25E-07
Cadmium	6.65E-06	5.80E-08	-	-	3.10E-05	8.54E-06	1.33E-05	6.16E-06	5.98E-06	4.45E-06
Chromium	1.69E-05	5.80E-08	-	-	7.89E-06	2.18E-06	3.39E-06	1.57E-06	1.52E-06	1.13E-06
Cobalt	4.90E-07	-	-	-	7.31E-06	6.37E-07	9.92E-07	4.59E-07	4.45E-07	3.31E-07
Copper	5.07E-06	1.16E-07	-	-	2.34E-05	6.45E-06	1.00E-05	4.65E-06	4.51E-06	3.35E-06
Lead	2.96E-06	3.74E-07	-	-	1.36E-05	3.81E-06	5.93E-06	2.75E-06	2.66E-06	1.98E-06
Manganese	2.24E-06	1.16E-07	-	-	1.04E-05	2.87E-06	4.46E-06	2.07E-06	2.01E-06	1.50E-06
Mercury	1.51E-06	5.80E-08	-	-	7.65E-06	1.94E-06	3.02E-06	1.40E-06	1.36E-06	1.01E-06
Nickel	1.27E-05	5.80E-08	-	-	5.92E-05	1.63E-05	2.54E-05	1.18E-05	1.14E-05	8.45E-06
Anthracene	2.84E-09	3.62E-08	-	-	1.33E-07	3.65E-08	5.69E-08	2.63E-08	2.55E-08	1.90E-08
Chrysene	9.06E-09	6.81E-09	-	-	4.51E-08	1.24E-08	1.94E-08	8.96E-09	8.69E-09	6.47E-09
Fluoranthene	1.75E-08	1.47E-07	-	-	8.18E-08	2.25E-08	3.51E-08	1.62E-08	1.58E-08	1.17E-08
Fluorene	1.63E-08	5.65E-07	-	-	7.61E-08	2.10E-08	3.27E-08	1.51E-08	1.47E-08	1.09E-08
Naphthalene	3.63E-06	1.64E-06	-	-	1.69E-05	4.66E-06	7.26E-06	3.36E-06	3.26E-06	2.42E-06
Phenanthrene	1.03E-07	5.69E-07	-	-	4.79E-07	1.32E-07	2.06E-07	9.52E-08	9.24E-08	6.87E-08
Benzo[a]pyrene	3.45E-07	3.64E-08	-	-	1.61E-06	4.43E-07	6.90E-07	3.19E-07	3.10E-07	2.30E-07
Acetaldehyde	7.26E-06	1.16E-07	-	-	3.38E-04	9.32E-05	1.45E-04	6.72E-05	6.52E-05	4.85E-05
Phosphorus	1.33E-05	-	-	-	6.20E-05	1.71E-05	2.66E-05	1.23E-05	1.20E-05	8.89E-06
Isooctane	-	-	1.84E-03	8.59E-03	-	-	-	-	-	-
Benzene	1.27E-05	3.86E-05	1.91E-03	3.87E-03	1.33E-07	1.03E-05	2.51E-05	1.18E-05	1.14E-05	1.90E-08
Formaldehyde	4.48E-04	2.28E-05	-	-	4.56E-08	5.75E-04	8.95E-04	4.15E-04	4.02E-04	6.47E-09
Toluene	2.05E-05	7.91E-06	7.18E-03	1.50E-02	8.19E-08	2.56E-05	3.99E-05	1.85E-05	1.79E-05	1.17E-08
Ethylbenzene	9.68E-05	-	1.69E-04	3.01E-03	7.62E-08	1.24E-04	1.94E-04	8.98E-05	8.69E-05	5.09E-08
Hexane	6.09E-02	-	1.75E-03	2.15E-03	1.69E-05	1.40E-02	2.18E-02	1.01E-02	9.78E-03	1.42E-06
Xylenes	1.51E-04	5.51E-06	7.43E-04	1.50E-02	4.79E-07	1.91E-04	3.03E-04	1.40E-04	1.36E-04	6.87E-08
Phenol	4.47E-06	-	-	-	1.63E-06	3.11E-05	4.86E-05	2.24E-05	2.17E-05	2.30E-07
Acrolein	1.03E-04	1.79E-06	-	-	3.39E-04	1.32E-04	2.06E-04	9.57E-05	9.24E-05	4.65E-05
Selenium	5.38E-06	2.90E-07	-	-	6.20E-05	6.84E-06	1.06E-05	4.93E-06	4.78E-06	8.89E-06
Cumene	-	-	3.69E-05	1.07E-03	-	-	-	-	-	-

Table E-2
Inhalation Risk Assessment - Maximum Modeled Unit Emission Rates

	New Sources				Modified Sources					
	851 Heater	New Emergency Air Compressor	100 M bbl Tank	Fugitive Emissions	581 Crude Heater	583 Vacuum Heater	Coker Unit Flare	Naphtha Splitter Heater	Heater R5	#1HDS Heater
Highest Unit Emission Rate (µg/m3 per g/sec)	1.06	63.68	8.43	13.62	0.49	0.48	0.08	0.41	0.44	0.43

Table E-3
Inhalation Risk Assessment - Maximum Ambient Concentration (µg/m³)

	New Sources				Modified Sources					
Pollutant	RSS Heater	New Emergency Air Compressor	500 M bbl Tank	Fugitive Emissions	SLI Crude Heater	SSI Vacuum Heater	Coker Unit Flare	Naphtha Splitter Heater	Heater HS	#3HDS Heater
Arsenic	1.70E-06	4.77E-06			2.76E-06	7.43E-07	1.98E-07	4.57E-07	4.74E-07	3.45E-07
Beryllium	8.37E-07	3.58E-06			1.79E-06	6.83E-07	1.29E-07	2.97E-07	3.08E-07	2.24E-07
Cadmium	7.09E-06	3.59E-06	-	-	1.52E-05	4.00E-06	1.09E-06	2.52E-06	2.61E-06	1.90E-06
Chromium	1.60E-06	3.58E-06	-	-	3.50E-06	1.04E-06	2.77E-07	6.40E-07	6.64E-07	4.83E-07
Cobalt	5.28E-07	-	-	-	1.13E-06	3.05E-07	8.11E-08	1.88E-07	1.95E-07	1.42E-07
Copper	5.35E-06	7.16E-06	-	-	1.54E-05	3.09E-06	8.22E-07	1.90E-06	1.97E-06	1.43E-06
Lead	3.16E-06	1.07E-05	-	-	6.76E-06	1.82E-06	4.85E-07	1.12E-06	1.16E-06	8.46E-07
Manganese	1.38E-06	7.16E-06	-	-	5.10E-06	1.37E-06	3.66E-07	8.46E-07	8.78E-07	6.39E-07
Mercury	1.61E-06	3.58E-06	-	-	3.45E-06	4.79E-07	2.47E-07	5.72E-07	5.93E-07	4.31E-07
Nickel	1.35E-05	3.58E-06	-	-	2.90E-05	7.80E-06	2.08E-06	4.80E-06	4.98E-06	3.63E-06
Anthracene	3.01E-08	2.79E-06	-	-	6.48E-08	1.75E-08	4.65E-09	1.07E-08	1.11E-08	8.11E-09
Chrysene	1.03E-08	4.79E-07	-	-	2.21E-08	5.95E-09	1.58E-09	3.66E-09	3.80E-09	2.76E-09
Fluoranthene	1.87E-08	9.89E-06	-	-	4.00E-08	1.08E-08	2.87E-09	6.63E-09	6.88E-09	5.01E-09
Fluorene	1.74E-08	3.48E-05	-	-	3.72E-08	1.00E-08	2.67E-09	6.17E-09	6.41E-09	4.66E-09
Naphthalene	7.86E-06	1.01E-04	-	-	1.20E-05	2.24E-06	5.91E-07	1.37E-06	1.42E-06	1.01E-06
Phenanthrene	1.10E-07	3.51E-05	-	-	2.34E-07	6.32E-08	1.68E-08	3.89E-08	4.03E-08	2.93E-08
Benzo(a)pyrene	3.67E-07	2.24E-07	-	-	7.86E-07	2.12E-07	5.64E-08	1.30E-07	1.35E-07	9.81E-08
Acetaldehyde	7.73E-05	7.16E-06	-	-	1.66E-04	4.46E-05	1.19E-05	2.74E-05	2.85E-05	2.07E-05
Phosphorus	1.42E-05	-	-	-	3.03E-05	8.18E-06	2.18E-06	5.03E-06	5.22E-06	3.80E-06
Isooctane	-	-	1.55E-02	1.32E-01	-	-	-	-	-	-
Benzene	1.35E-05	1.11E-03	1.61E-02	5.20E-02	6.48E-03	7.80E-06	2.08E-06	4.80E-06	4.98E-06	8.18E-09
Formaldehyde	4.77E-04	1.41E-03			2.21E-04	2.76E-04	7.37E-05	1.69E-04	1.76E-04	1.76E-09
Toluene	2.13E-05	4.88E-04	1.84E-02	2.05E-01	4.00E-03	1.23E-05	3.26E-06	7.55E-06	7.83E-06	5.01E-09
Ethylbenzene	1.01E-03	-	1.43E-03	4.09E-02	3.72E-08	5.95E-05	1.58E-05	3.66E-05	3.80E-05	4.66E-09
Hexane	1.66E-02	-	1.48E-02	2.92E-02	8.26E-06	6.69E-03	1.78E-03	4.11E-03	4.27E-03	1.04E-05
Xylenes	1.61E-04	3.40E-04	6.26E-03	2.05E-01	2.34E-07	9.29E-05	2.47E-05	5.72E-05	5.93E-05	2.93E-08
Phenol	7.58E-05	-		-	7.86E-07	5.49E-05	3.96E-06	9.15E-06	9.49E-06	9.84E-08
Acrolein	1.60E-04	1.80E-04	-	-	1.66E-04	6.32E-05	1.68E-05	3.89E-05	4.03E-05	2.07E-05
Selenium	5.67E-06	1.79E-05	-	-	3.03E-06	3.27E-06	8.70E-07	2.01E-06	2.09E-06	1.80E-06
Cumene	-	-	3.31E-04	5.40E-02	-	-	-	-	-	-

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Table E-4

Inhalation Risk Assessment - Unit Risk Factors for HAPs

Pollutant	CAS No.	Unit Risk Factor $1/(\mu g/m^3)$
Arsenic	7440-38-2	4.30E-03
Beryllium	7440-41-7	2.40E-03
Cadmium	7440-43-9	1.80E-03
Chromium	18540-29-9	1.20E-02
Cobalt	7440-48-4	
Copper		
Lead	7439-92-1	
Manganese	7439-96-5	
Mercury	7439-97-6	
Nickel	7440-02-0	4.80E-04
Anthracene	120-12-7	
Chrysene	218-01-9	1.10E-05
Fluoranthene	206-44-0	
Fluorene	86-73-7	
Naphthalene	91-20-3	3.40E-05
Phenanthrene	85-01-8	
Benzo(a)pyrene	50-32-8	1.10E-03
Acetaldehyde	75-07-0	2.20E-06
Phosphorus	7723-14-0	
Isooctane	540-84-1	
Benzene	71-43-2	7.80E-06
Formaldehyde	50-00-0	1.30E-05
Toluene	108-88-3	
Ethylbenzene	100-41-4	2.50E-06
Hexane	110-54-3	
Xylenes	1330-20-7	
Phenol	108-95-2	
Acrolein	107-02-8	
Selenium	7782-49-2	
Cumene	98-82-8	

Table 6-5
Inhalation Risk Assessment - Cancer Risk by Source and Total Risk

	New Sources				Modified Sources					
Pollutant	BSI Heater	New Emergency Air Compressor	100 M bbl Tank	Fugitive Emissions	583 Crude Heater	583 Vacuum Heater	Coker Unit Flare	Naphtha Splitter Heater	Heater HS	HTRDS Heater
Arsenic	5.54E-03	2.05E-02	ND	ND	1.19E-02	3.20E-03	8.51E-04	1.97E-03	2.09E-03	1.48E-03
Beryllium	2.06E-03	8.59E-03	ND	ND	4.30E-03	1.16E-03	3.09E-04	7.13E-04	7.40E-04	5.39E-04
Cadmium	1.28E-02	6.44E-03	ND	ND	2.73E-02	7.36E-03	1.96E-03	4.53E-03	4.70E-03	3.42E-03
Chromium	2.16E-02	4.29E-02	ND	ND	4.63E-02	1.25E-02	3.37E-03	7.68E-03	7.97E-03	5.80E-03
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Manganese	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	6.49E-03	1.72E-03	ND	ND	1.39E-02	3.75E-03	9.97E-04	2.30E-03	2.39E-03	1.74E-03
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	1.13E-07	4.69E-06	ND	ND	2.43E-07	6.54E-08	1.74E-08	4.07E-08	4.18E-08	3.04E-08
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	1.31E-04	3.44E-03	ND	ND	2.81E-04	7.58E-05	2.02E-05	4.66E-05	4.84E-05	3.52E-05
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	4.04E-04	2.47E-04	ND	ND	8.65E-04	2.33E-04	6.20E-05	1.43E-04	1.49E-04	1.08E-04
Acetaldehyde	1.70E-04	1.57E-05	ND	ND	3.64E-04	9.81E-05	2.61E-05	6.01E-05	6.26E-05	4.56E-05
Phosphorus	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isooctane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	3.06E-04	8.68E-03	5.25E-05	6.11E-01	5.06E-07	6.09E-05	1.62E-05	3.75E-05	3.89E-05	6.33E-08
Formaldehyde	6.70E-03	1.85E-02	ND	ND	2.57E-07	3.57E-03	9.51E-04	2.20E-03	2.28E-03	3.59E-08
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	7.58E-04	ND	3.57E-03	1.02E-01	9.33E-08	1.49E-04	3.96E-05	9.15E-05	9.49E-05	1.17E-08
Hexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cumene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

	New Sources				Modified Sources					
Total HAP Carcinogenic Risk By Unit	BSI Heater	New Emergency Air Compressor	100 M bbl Tank	Fugitive Emissions	583 Crude Heater	583 Vacuum Heater	Coker Unit Flare	Naphtha Splitter Heater	Heater HS	HTRDS Heater
	5.57E-02	1.12E-05	1.29E-01	5.11E-01	1.05E-01	3.71E-02	8.55E-03	1.98E-02	2.05E-02	1.32E-02

Total HAP Carcinogenic Risk	Cancer Risk
	1.0E+00

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APPENDIX F
MODELING RESULTS FOR CLASS I AREA IMPACTS

The following attachments are included in this appendix in the following order:

- Table F-1: Class I Impact Analysis – Annual NO_2 Results
- Table F-2: Class I Impact Analysis – Annual SO_2 Results
- Table F-3: Class I Impact Analysis – 24-hr SO_2 Results
- Table F-4: Class I Impact Analysis – 3-hr SO_2 Results
- Table F-5: Class I Impact Analysis – Annual PM_{10} Results
- Table F-6: Class I Impact Analysis – 24-hr PM_{10} Results
- Table F-7: Class I Impact Analysis – Annual $PM_{2.5}$ Results
- Table F-8: Class I Impact Analysis – 24-hr $PM_{2.5}$ Results

Table F-1
Class I Impact Analysis - Annual NO_2 Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] ($\mu g/m^3$)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.

Table F-2
Class I Impact Analysis - Annual SO_2 Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] (ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.

Table F-3
Class I Impacts Analysis - 24-hr SO_2 Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	364825.87	4597107.19	0.0027

[1] Maximum Modeled Concentration.

Table F-4
Class I Impacts Analysis - 3-hr SO_2 Results

Year	UTM(E) (m)	UTM(N) (m)	Concentration[1] ($\mu g/m^3$)
2008	311112.22	4579134.86	0.0103
2009	369444.42	4649897.46	0.0235
2010	364825.87	4597107.19	0.0435

[1] Maximum Modeled Concentration.

Table F-5
Class I Impacts Analysis - Annual PM_{10} Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.

Table F-6
Class I Impact Analysis - 24-hr PM_{10} Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.

Table F-7
Class I Impacts Analysis - Annual $PM_{2.5}$ Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.

Table F-8
Class I Impacts Analysis - 24-hr $PM_{2.5}$ Results

Year	UTM(E)	UTM(N)	Concentration[1]
	(m)	(m)	(ug/m^3)
2008	--	--	0.00
2009	--	--	0.00
2010	--	--	0.00

[1] Maximum Modeled Concentration.